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THE MOUNTAIN ANTS OF WESTERN NORTH AMERICA.

By William Morton Wheeler.

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THE MOUNTAIN ANTS OF WESTERN NORTH AMERICA.[1]

By William Morton Wheeler.

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The study of several collections of ants received from Professors J. C. Bradley, C. F. Baker, T. D. A. Cockerell, C. C. Adams, S. J. Hunter, Dr. W. M. Mann, Dr. R. V. Chamberlin, Mr. E. J. Oslar and others and of my own collections made during several seasons in Colorado, New Mexico, Texas, Arizona and Southern California, and especially during the summer of 1915 in the Yosemite Valley and at Lake Tahoe, California and in the Canadian Rockies, enables me to give a much more consistent and comprehensive account of the distribution of the Formicidae of Western North America than was possible heretofore. These collections represent two distinct faunas, one of which belongs to Merriam's Lower and Upper Sonoran Zones and comprises species of several neotropical and tropicopolitan genera and subgenera, while the other, occurring at higher elevations belongs to Merriam's Transition and Canadian Zones and is represented by species of the genera *Monomorium, Solenopsis, Myrmecina, Myrmica, Leptothorax, Aphaenogaster, Stenamma, Liometopum, Tapinoma, Prenolepis s. str., Lasius, Formica, Polyergus* and a few subgenera of *Camponotus* (*Camponotus s. str. and Myrmoturba*). There is some overlapping of the Sonoran and mountain faunas due to the ascent of such forms as *Pogonomyrmex occidentalis, Myrmecocystus mexicanus* and a few species of *Crematogaster, Pheidole* and *Solenopsis* into the Transition Zone and the descent of a few species of *Camponotus s. str., Myrmica* and *Formica* into the Sonoran Zones. In the following pages I have listed the known forms belonging to the Transition and Canadian Zones of Western North America and have added descriptions of 32 new forms (three species, twelve subspecies and seventeen varieties) which I have been able to recognize among the recently collected material. I have not included any of our Pone-

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1 Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 118.

rinae in the list, because the distribution of the species of *Ponera*, *Stigmatomma*, *Proceratium* and *Sysphincta*, with the exception of *Ponera coarctata* subsp. *pennsylvanica*, is imperfectly known, and because I have no new data for publication. The ants of the genera *Proceratium* and *Sysphincta* are very rare and seem to belong to the Upper and Lower Austral Zones, but they will probably be discovered in the Western States. I have, in fact, seen a male specimen which seems to belong to one of these genera, from California. *Ponera pennsylvanica* is confined to the Eastern and Central States, Ontario and Nova Scotia. The genus is represented in the Western and Southern States by at least two closely allied species (*P. trigona* var. *opacior* and *P. opaciceps*), whose precise distribution is still unknown.

The great importance of the ants in the study of geographical distribution has not been overlooked by students of this fascinating subject. These insects are, indeed, specially fitted for the mapping of geographical areas, for several reasons. They are not, like many other groups of insects, absolutely dependent on specific food-plants, their colonies are stable and stationary entities, chained to the soil or to certain general plant associations, and they are exceedingly sensitive to climatic and other environmental influences as shown by the extraordinary development of geographical races (subspecies) and varieties in practically all the species of extensive range. A few authors have attempted to minimize these peculiarities on the ground that the marriage-flight of male and female ants must permit of a wide dissemination of the species. It is true that many species of ants have a very wide range, e. g. *Formica fusca*, which is circumpolar and *Camponotus maculatus* which is cosmopolitan, but this is, in all probability, the result of great geologic age, and while we must admit that the nuptial flight of the female ant is practically the only means of rapidly disseminating the species, it is easy to exaggerate its importance. It is natural to suppose that small flying insects, like many female ants, must be carried long distances by air-currents, and these females, when fecundated, are, of course, so many potential colonies. But such observations as can be made in the field do not support this supposition. Most female ants are heavy-bodied and have feeble powers of flight. Moreover, the time during which they can use their wings, especially after fecundation, is limited to a few hours at most. The wing muscles very soon begin to degenerate and compel the insects to descend, abandon their organs of flight and become as completely terrestrial as the workers. During marriage flights female

ants are therefore usually observed to return in great numbers to the ground at no great distance from their parental nests.

The height to which ants are able to ascend on their nuptial flights will be ascertained only when some of our young myrmecologists become aviators. We know that winged ants are often carried to high mountain peaks. Forel (1874) records the occurrence of males and females of *Formica rufa* and *pratensis* on the perpetual snows of Alpine glaciers, and Mrs. Slosson sent me several male and female ants of different genera from the summit of Mt. Washington, N. H. (Wheeler 1905). I have myself taken similar specimens on the summits of other peaks in the White Mountains. But, as Forel has shown, female ants never succeed in establishing colonies at these altitudes. They are merely transported to the summits by the air-currents which are known to ascend mountain slopes during the day-time and to carry up great numbers of insects of all orders. Unless, therefore, such females were able to descend on the opposite slopes,— and this is probably of very rare occurrence — high mountain ranges must constitute barriers as effective as are considerable bodies of water or deserts to the distribution of most ants. I am convinced that the Sierra Nevada in California is such a barrier to many forms common on the Pacific Coast and in Europe the Alps certainly act as a similar barrier to many species common in Italy and Central Europe.

For the purpose of bringing before the reader as clearly as possible the results of my study of the ants of the Transition and Canadian Zones, I have cited the various species, subspecies and varieties from the Coast Range of California, the Sierra-Cascade Ranges, the Rocky Mountains and the portion of North America east of these ranges in four columns in the accompanying Tables I to IX (pp. 464 to 481). As might be expected, the great ranges of the Rocky Mountains, from British America to Mexico, show the greatest number and diversity of forms. The Eastern portion of North America has, with the exception of a certain number of holarctic and neotropical species, a fauna peculiar to itself, and the Sierras and Californian Coast each possesses peculiar elements, though also possessing many forms in common with the Rocky Mountains. One is struck in the tables by the meagerness of the two Californian mountain faunas. This might be attributed to their much smaller territory, but such can hardly be a complete explanation, for ant-colonies in California, even those of the more dominant species, are much less numerous than they are in the Rocky Mountains and Eastern States. I believe that the difference is due to the peculiar annual distribution of temperature and mois-

ture in California. The ants of the Transition and Boreal Zones require a considerable amount of humidity and warmth during their breeding season. These conditions are not realized simultaneously in California, where the rainy season comes during the winter and the summer is rainless except in the high Sierras. The more perfect adaptation of the species of the Sonoran zones to a smaller amount of moisture and to winter temperatures not sufficiently low to inhibit completely the activities of the worker ants, probably accounts for the greater number of species and colonies at lower altitudes in Southern California, where the conditions are much like those of Arizona. Even moderately low temperatures, when coupled with considerable humidity, a condition which prevails in California during the winter months, is very unfavorable to ants, and when such conditions are most accentuated, the ant-fauna is reduced to a mere remnant, although the vegetation, if the temperature is not too low, may be luxuriant. This is the case in New Zealand where I sometimes searched in vain for an ant-colony in forests whose luxuriance rivalled those of the tropics. But we have a striking example of the depressing effects of cold and moisture on ant-life much nearer home. The cool Selkirk Mts. of British Columbia have an abundant supply of moisture and an unusually rich flora, but their ant-fauna is reduced to a few boreal species. The adjacent Canadian Rockies, however, though in the same latitude, are less humid and have a poorer flora, but their ant-fauna is decidedly richer in species and colonies.

In mountain regions slope exposure in its relation to insolation is a very important factor in the local distribution of ants, but it is impossible at present to give more than a general statement in regard to this matter. Northern slopes in the northern hemisphere are usually, for very obvious reasons, almost or quite destitute of ants. In regard to the other slopes my observations in the Alps of Switzerland and the mountains of the United States, British America, Mexico and Central America confirm those of Forel in the Alps and the mountains of North Carolina. He finds that ants prefer the eastern and southern slopes as these are the situations in which they have the longest day for their activities during the breeding season, since they are early awakened by a sufficiently high temperature of the soil and air from the lethargy induced by the chill night hours, and even though the slope may be in shade during the afternoon the warmth is sufficient to sustain their activities till sun-set. On western slopes, however, the morning hours are too cool and are therefore practically lost to the ants, whereas the afternoon hours are too warm.

This preference of our northern ants for eastern and southern slopes is further confirmed by the shape of the nest and the position of the nest-entrance of certain species. This matter was considered in my ant-book (1910, p. 205) in the following passage: "I have already called attention to the constant position of the nest opening at the base of the southern or eastern slope of the mounds of *Pogonomyrmex occidentalis*. Huber says that the yellow ants (*Lasius flavus*) of Switzerland "serve as compasses to the mountaineers when they are enveloped in dense fogs or have lost their way at night; for the reason that the nests, which in the mountains are much more numerous and higher than elsewhere, take on an elongated, almost regular form. Their direction is constantly from east to west. Their summits and more precipitous slopes are turned towards the winter sunrise, their longer slopes in the opposite direction." These remarks of Huber have been recently confirmed by Tissot (Wasmann 1907) and Linder (1908). The latter has shown that the elongate shape of the mounds is due to the fact that the ants keep extending them in an easterly direction in such a manner that only the extreme easterly, highest and most precipitous portions are inhabited by the insects. I have observed a similar and equally striking orientation of the mounds of *Formica argentata* [*fusca* var. *argentea*] in the subalpine meadows of Colorado." In the southern hemisphere, as we should expect, the ants prefer the northern and eastern slopes of the mountains. I found many striking instances of this preference while collecting in the mountains of New Zealand, New South Wales and Queensland.

Merriam and his collaborators in their studies of the floras and faunas of the mountains of western North America have published interesting observations which deserve consideration since they have a bearing on the distribution of the Formicidae though they show that these insects would hardly suffice to determine the boundaries of the various life-zones on mountain slopes. In his work on Mt. Shasta, Merrian (1899) says: "The influence of slope exposure on the faunas and floras of mountain regions is profound. Measured by a scale of altitudes it amounts on ordinary slopes to nearly a thousand feet and on steep slopes is still more marked. Thus on mountains it is usual for plants and animals of particular species to occur on warm southwesterly slopes at elevations 800 to 1000 feet higher than on cool northeasterly slopes — similarly on north and south ridges, the fauna and floras of the warm west slopes often belong to lower zones than those of equal elevations on the cool east slopes." Merriam had previously shown the existence of very similar conditions in a very differ-

ent region, the San Francisco Mountains of Arizona (1890). There he found the normal difference in altitude of the same zone on the southwest and northeast slopes to be about 900 feet. After giving numerous examples of this altitudinal distribution on Mt. Shasta, he calls attention to other factors, besides those of insolation, which influence the range of plants and animals: "It is well-known that in ordinary calm weather the air-currents on mountain sides and in deep canyons ascend by day and descend by night. The ascending currents are warm, the descending currents cold. The night current, being in the main free from local influences that affect its temperature, must exert an essentially equal affect on all sides of a mountain; but the temperature of the ascending day current, being constantly exposed to and in fact created by the influence of the sun, must vary enormously on different slopes. The activity and effectiveness of this current increase with the steepness of the slope and the directness of its exposure to the afternoon sun. Hence the hottest normal slopes— those that face the sun at nearly a right angle during the hottest part of the day — are rendered still more potent by increased steepness, the direct exposure of the sun keeping up the supply of heat while the steepness of the slope accelerates the rate of movement of the diurnal ascending current, carrying the heated air upward a very great distance before it has time to be cooled to the general temperature of the stratum it penetrates. Thus it is that species characteristic of the Transition zone on Shasta — species which on normal southwesternly slopes attain their upper limits at an altitude of 5500 to 5700 feet — are in favorable places enabled to live at elevations of 7900 or even 8000 feet, considerably more than 2000 feet above their normal limits."

Every observer in the field must have been impressed with the fact that steepness of slope is an important factor in the local distribution of mountain ants. These insects always greatly prefer the more gradual slopes and alpine meadows, probably because the soil of such places retains a more abundant and more equable supply of moisture and because their surfaces are much less exposed to rapid evaporation both from direct insolation and from air-currents. All of these ecological factors demand much more careful study.

It is, of course, well known that the delimitation of the various life-zones in mountain regions depends not only on slope-exposure but also on latitude. That the upper limit of the zones descends in more northern and ascends in more southern latitudes even within the confines of a single one of our western states is well shown in the fol-

lowing table from Cary's "Biological Survey of Colorado" (1911):

Zone	North Colorado		Southern Colorado	
	Northeast exposure	Southwest exposure	Northeast exposure	Southwest exposure
	Feet	Feet	Feet	
Upper Soronan	—— to 5600	—— to 6500	—— to 6500	—— to 7800
Transition	5600 to 7500	6500 to 8200	6500 to 8000	7800 to 9000
Canadian	7500 to 10000	8200 to 10400	8000 to 10500	9000 to 11000
Hudsonian	10000 to 10900	10400 to 11600	10500 to 11200	11000 to 12000
Arctic-Alpine	10900 to ——	11600 to ——	11200 to ——	12000 to ——

In his "Life Zones and Crop Zones of New Mexico, Bailey (1913) gives the upper boundary of the Upper Sonoran as 5000–7000 or even 8000 ft., the boundaries of the Transition as extending from 7000 to 8500 ft. on northeastern and 8000 to 9500 on southwestern slopes, of the Canadian as from 8500 to 11,000 and on warm slopes from 9500 to 12,000, of the Hudsonian from 11,000 to 12,000 on northeastern and 12,000 to 13,000 on southwestern slopes, the Arctic-Alpine on the Sangre de Cristo Range as all above 12,000 ft. on the coldest slopes, and on especially steep slopes as all above 11,500 ft.; on the warmest slopes as all above 13,000 ft. or on very gradual slopes all above 12,500 ft. In Arizona the boundaries of the life-zones ascend somewhat higher, as indicated by the following altitudes from Merriam's work (1890) on the San Francisco Mountains (southwest slopes): Lower Sonoran 4000–6000 ft., Upper Sonoran 6000–7000 ft., Transition 7000–8200 ft., Canadian 8200–9200 ft., Hudsonian 9200–10,500 ft., Arctic-Alpine 10,500–11,500 ft. In the Chisos, Davis and Guadeloupe Mountains of Western Texas, according to Bailey (1905) the Transition Zone extends from about 6000 ft. on northeast slopes to the top of the ranges (8000–9500 ft.). In Mexico the upper boundary of the Transition must be even higher. North of Colorado the zonal boundaries descend rapidly till in the latitude of Vancouver and Maine the Canadian zone, which extends across the continent, is at sea-level, so that we find at this level such forms as *Camponotus whymperi*, *modoc*, and *laevigatus*, the two latter of which do not descend below 4000 to 6000 ft. in the Sierras, while *whymperi* and *laevigatus* are not known from elevations under 7000 to 8000 ft. in Colorado. On the other

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Monomorium	**Monomorium**
	minimum
minimum subsp. *ergatogyna*	
Solenopsis	**Solenopsis**
molesta var. validiuscula	
Myrmecina	**Myrmecina**
Myrmica	**Myrmica**
	brevinodis var. sulcinodoides
	var. subalpina
	scabrinodis subsp. schencki var. *tahoënsis*
	bradleyi

I.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Monomorium	**Monomorium**
minimum	minimum
subsp. *compressum*	
subsp. *cyaneum*	
Solenopsis	**Solenopsis**
molesta	molesta
var. validiuscula	
var. *castanea*	
Myrmecina	**Myrmecina**
graminicola subsp. americana	graminicola subsp. americana
var. brevispinosa	var. brevispinosa
subsp. *texana*	
Myrmica	**Myrmica**
brevinodis	
var. sulcinodoides	brevinodis var. *canadensis*
var. *decedens*	
var. *brevispinosa*	
var. subalpina	
var. *frigida*	
scabrinodis subsp. *lobicornis* var. *glacialis*	scabrinodes var. *sabuleti*
	var. *fracticornis*
	var. *detritinodis*
scabrinodis subsp. schencki var. *monticola*	scabrinodis subsp. schencki var. *emeryana*
mexicana	*punctiventris*
	var. *pinetorum*
mutica	*rubra* subsp. *laevinodis* var. *bruesi*
aldrichi	subsp. *neolaevinodis*
hunteri	subsp. *champlaini*

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Leptothorax	**Leptothorax**
andrei	
eldoradensis	
nitens var. *heathi*	nitens
var. *mariposa*	
var. *occidentalis*	
	nevadensis
	subsp. *rudis*
	rugatulus var. *mediorufus*
	acervorum subsp. canadensis var. *calderoni*
Symmyrmica	**Symmyrmica**
Harpagoxenus	**Harpagoxenus**

II.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Leptothorax	**Leptothorax**
schmitti	
neomexicanus	
nitens	
tricarinatus	
melanderi	
furunculus	*longispinosus*
mexicanus	*fortinodis*
terrigena	*schaumi*
texanus	texanus var. *davisi*
obturator	
rugatulus	*curvispinosus*
var. *cockerelli*	subsp. *ambiguus*
subsp. *annectens*	
subsp. *brunnescens*	
muscorum var. *sordidus*	
var. *septentrionalis*	
acervorum subsp. canadensis	acervorum subsp. canadensis
var. convivialis	var. convivialis
var. *yankee*	
subsp. *crassipilis*	
emersoni subsp. *glacialis*	*emersoni*
subsp. *hirtipilis*	
hirticornis subsp. *formidolosus*	*hirticornis*
provancheri	
Symmyrmica	**Symmyrmica**
chamberlini	
Harpagoxenus	**Harpagoxenus**
	americanus

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Stenamma	**Stenamma**
brevicorne subsp. *heathi*	
subsp. *sequoiarum*	
nearcticum	
Aphaenogaster	**Aphaenogaster**
subterranea subsp. occidentalis	subterranea subsp. occidentalis
	subsp. valida var. *manni*
patruelis	
var. *bakeri*	
var. *carbonaria*	
mutica	
Liometopum	**Liometopum**
occidentale	apiculatum
apiculatum subsp. luctuosum	

III.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Stenamma	**Stenamma**
	brevicorne
brevicorne subsp. diecki	subsp. diecki
	var. *impressum*
	subsp. *impar*
	subsp. *schmitti*
manni	
Aphaenogaster	**Aphaenogaster**
subterranea subsp. occidentalis	*fulva*
subsp. *valida*	subsp. *aquia*
subsp. *borealis*	var. *picea*
fulva subsp. aquia var. rudis	var. rudis
var. *azteca*	
uinta	
texana	
var. *furvescens*	texana var. *carolinensis*
	mariae
mutica	*tennesseensis*
	var. *ecalcarata*
	treatae
	subsp. *wheeleri*
	lamellidens
Liometopum	**Liometopum**
apiculatum	
subsp. luctuosum	

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Tapinoma	**Tapinoma**
sessile	sessile
Prenolepis	**Prenolepis**
imparis	imparis
Lasius	**Lasius**
niger var. sitkaënsis	niger var. sitkaënsis
var. neoniger	var. neoniger
	subsp. alienus var. americanus
	brevicornis subsp. *microps*
	flavus subsp. claripennis
	umbratus subsp. subumbratus
	humilis
	latipes
interjectus subsp. *californicus*	

IV.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Tapinoma	**Tapinoma**
sessile	sessile
Prenolepis	**Prenolepis**
imparis	imparis
	var. *testacea*
	var. *parva*
Lasius	**Lasius**
niger var. sitkaënsis	niger var. sitkaënsis
var. neoniger	var. neoniger
subsp. alienus var. americanus	subsp. alienus var. americanus
brevicornis	brevicornis
flavus subsp. nearcticus	flavus subsp. nearcticus
subsp. claripennis	
umbratus subsp. subumbratus	umbratus subsp. subumbratus
subsp. mixtus var. aphidicola	subsp. mixtus var. aphidicola
subsp. *vestitus*	subsp. *speculiventris*
	subsp. *minutus*
latipes	latipes
occidentalis,	
murphyi	murphyi
interjectus	interjectus
subsp. *coloradensis*	
subsp. *arizonicus*	
subsp. *mexicanus*	
claviger	claviger
	subsp. *subglaber*

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Formica	**Formica**
sanguinea subsp. subnuda	sanguinea subsp. subnuda
	manni
	rufa subsp. obscuripes
	var. melanotica
truncicola subsp. integroides	truncicola subsp. integroides
var. *subfasciata*	var. *tahoënsis*
	var. *propinqua*
	var. haemorrhoidalis
subsp. integra var. subcaviceps	subsp. integra var. subcaviceps
	oreas var. comptula

V.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Formica	**Formica**
sanguinea subsp. subnuda	sanguinea subsp. subnuda
subsp. puberula	subsp. puberula
	subsp. *subintegra*
	var. *gilvescens*
subsp. *obtusopilosa*	subsp. *rubicunda*
	var. *sublucida*
munda	subsp. *aserva*
var. *alticola*	*pergandei*
manni	
perpilosa	
bradleyi	
rufa subsp. obscuripes	
var. melanotica	rufa subsp. obscuripes var. melanotica
truncicola subsp. integroides var. *coloradensis*	
var. *ravida*	
var. haemorrhoidalis	
subsp. *mucescens*	
subsp. obscuriventris var. *aggerans*	truncicola subsp. *obscuriventris*
	var. *gymnomma*
subsp. integra	subsp. integra
foreliana	*ferocula*
ciliata	
comata	
criniventris	
oreas	
var. comptula	

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Formica	**Formica**
	microgyna subsp. rasilis
	var. *pinetorum*
	subsp. *californica*
	var. *hybrida*
	nevadensis
fusca	fusca
	var. marcida
	var. subaenescens
var. argentea	var. argentea
var. neorufibarbis	var. neorufibarbis
	var. *blanda*
	subsp. pruinosa var. *lutescens*
rufibarbis var. *occidua*	

VI.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Formica	**Formica**
dakotensis	
var. *montigena*	dakotensis var. *speculiventris*
var. *saturata*	
microgyna	microgyna subsp. *scitula*
var. *recidiva*	*difficilis*
subsp. rasilis	var. *consocians*
var. *spicata*	*impexa*
var. *pullula*	*nepticula*
var. *nahua*	*morsei*
whymperi	
var. *alpina*	whymperi var. *adamsi*
exsectoides var. *hesperia*	*exsectoides*
subsp. *opaciventris*	var. *davisi*
ulkei	ulkei
	var. *hebescens*
fusca	fusca
var. marcida	
var. subsericea	var. subsericea
var. subaenescens	var. subaenescens
var. argentea	var. argentea
var. *gelida*	var. *algida*
var. neorufibarbis	
var. *neoclara*	
subsp. *pruinosa*	
rufibarbis var. *gnava*	

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Formica	**Formica**
cinerea var. neocinerea	
var. *lepida*	
subsp. *pilicornis*	
	sibylla
subpolita	
var. camponoticeps	subpolita var. camponoticeps
	neogagates
neogagates subsp. lasioides var. vetula	subsp. lasioides var. vetula
Polyergus	**Polyergus**
rufescens subsp. breviceps	rufescens subsp. breviceps
var. *umbratus*	
subsp. *laeviceps*	

VII.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Formica	**Formica**
cinerea var. neocinerea	cinerea var. neocinerea
var. *altipetens*	var. *rutilans*
var. *canadensis*	
montana	
hewitti	
subcyanea	
subpolita var. *ficticia*	
neogagates	neogagates
var. *morbida*	var. *vinculans*
subsp. lasioides	subsp. lasioides
var. vetula	var. vetula
limata	
	pallidefulva
	var. *succinea*
	subsp. *schaufussi*
	var. *dolosa*
pallidefulva subsp. schaufussi var. incerta	var. incerta
subsp. nitidiventris	subsp. nitidiventris
var. fuscata	var. fuscata
moki	
Polyergus	**Polyergus**
rufescens subsp. breviceps	rufescens subsp. breviceps
var. *montezuma*	
var. *fusciventris*	
subsp. *mexicanus*	
subsp. bicolor	subsp. bicolor
lucidus subsp. *montivagus*	*lucidus*

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Camponotus	**Camponotus**
laevigatus	laevigatus
	herculeanus var. modoc
	subsp. ligniperda var. noveboracensis
hyatti	
var. *bakeri*	
anthrax	
fallax var. nearcticus	fallax var. nearcticus
	var. minutus
subsp. subbarbatus	
subsp. discolor var. clarithorax	subsp. discolor var. clarithorax

VIII.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Camponotus	**Camponotus**
laevigatus	
herculeanus, var. modoc	
var. whymperi	herculeanus var. whymperi
	subsp. *pennsylvanicus*
	var. *ferrugineus*
	var. *mahican*
subsp. ligniperda var. noveboracensis	subsp. ligniperda var. noveboracensis
	var. *rubens*
schaefferi	*castaneus*
texanus	subsp. *americanus*
sayi	
fallax var. nearcticus	fallax var. nearcticus
var. minutus	var. minutus
var. decipiens	var. decipiens
	var. *tanquaryi*
	var. *pardus*
subsp. *rasilis*	
var. *pavidus*	
	subsp. subbarbatus
	var. *paucipilis*
subsp. discolor	subsp. discolor
var. clarithorax	var. clarithorax
	var. *cnemidatus*

TABLE

A. Pacific Coast Transition	B. Sierra-Cascade Transition and Boreal
Camponotus	**Camponotus**
maculatus subsp. vicinus	maculatus subsp. vicinus
var. plorabilis	
var. luteangulus	
var. semitestaceus	var. semitestaceus
var. nitidiventris	
var. *maritimus*	
var. infernalis	var. infernalis
subsp. *dumetorum*	
subsp. *maccooki*	
fumidus var. *fragilis*	
ocreatus	
mina	
yogi	

IX.

C. Rocky Mountain Transition and Boreal	D. Eastern Transition and Boreal
Camponotus	**Camponotus**
maculatus subsp. vicinus	
var. plorabilis	
var. luteangulus	
var. nitidiventris	
var. infernalis	
subsp. *sansabeanus*	
var. *torrefactus*	
subsp. *bulimosus*	
fumidus var. *festinatus*	
var. *spurcus*	
vafer	
acutirostris	
var. *clarigaster*	
ocreatus subsp. *primipilaris*	
mina subsp. *zuni*	
bruesi	
ulcerosus	
pylartes	*impressus*
var. *hunteri*	
abditus var. *etiolatus*	

hand, in the Huachuca Mountains of Arizona such neotropical forms as species of *Eciton, Odontomachus, Pheidole,* etc. are abundant at altitudes of 4000 to 6000 ft.[2]

Before considering the historical problems suggested by the ant-faunas of the four regions of the tables, it will be advisable to analyze them more closely. The total number of forms recorded for all the regions is 422 distributed as follows:

A	B	C	D
58 or 13.7%	60 or 14.2%	180 or 42.6%	124 or 29.4%

In reality the total number of *different* forms is only 311. If we count only the forms peculiar, endemic, or precinctive to each region (printed in italics in the tables) we have the following:

	A	B	C	D	Totals
Species	11	5	47	25	88
Subspecies	7	3	27	18	55
Varieties	11	10	38	32	91
	29	18	112	75	234

There are therefore 77 forms common to two or more of the regions. This would yield the following percentages for the given groups:

A	B	C	D	Common
9.3%	5.8%	36.0%	24.1%	24.8%

The total number of endemic forms in the western fauna (A + B + C) is 159 or 68%, whereas the 75 eastern forms represent only 32%. The number of forms in common gives a good index of the affinities of the different regions, and may be tabulated as follows:

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2 In his interesting paper on the insects of Custer County, Colorado, Cockerell (1893) does not accept Merriam's terminology for the life-zones of that region. He distinguishes three zones, a "subalpine," up to about 6500 ft., a "mid-alpine" between 6500 and 10,000 ft. and a "high-alpine" zone above the latter elevation, and correlates these with Merriam's zones in the statement that "an analysis of the insects of the Colorado Mountains shows that the high-alpine and mid-alpine elements, though sufficiently distinct, are both essentially boreal. If we follow Dr. Merriam's arrangement, it appears that the high-alpine is truly boreal, while the mid-alpine belongs to the transition region, containing a considerable number of strictly American types. The subalpine, on the other hand is southern or Sonoran."

Faunas of the Four Regions	Species in common	Subspecies in common	Varieties in common	Total number of forms in common	Percentages
A + B	4	6	12	22	28.7%
A + B + C	4	5	8	17	22.1%
A + B + C + D	3	2	6	11	14.3%
A + C	5	5	14	24	31.2%
B + C	8	9	19	36	46.7%
B + D	6	4	11	21	27.3%
C + D	12	14	21	47	61.0%
A + D	3	2	7	12	15.6%
B + C + D	6	3	11	20	26.0%
A + C + D	3	2	7	12	15.6%
A + B + D	3	2	6	11	14.3%

As would be expected, the affinities between the Pacific Coast and Eastern faunas are least developed, while those between the Sierra-Cascade and Rocky Mts. and especially those between the latter and the Eastern fauna are much greater.

If to the Transition and Boreal forms included in the tables we add the species, subspecies and varieties of the Lower and Upper Sonoran and Lower and Upper Austral Zones, the quantitative and qualitative differences between the western and eastern ant-faunas are even more striking. The same would be true of a comparison of the subgenera and genera of the two regions, for we find that, if we exclude the neotropical elements, no less than eight genera and subgenera are restricted to the western fauna (*Liometopum*, *Messor*, *Deromyrma*,

Neomyrma, Symmyrmica and *Myrmecocystus*) and seven are peculiarly eastern (*Bothriomyrmex, Hypoclinea, Strumigenys, Epoecus, Dichothorax, Harpagoxenus* and *Brachymyrmex*). Moreover certain genera are almost exclusively western or eastern. *Pogonomyrmex* e. g., represented by numerous species in the Southwestern States has only one species (*P. badius*) in the Southeastern States, and *Proceratium* and *Sysphincta* are at any rate very largely confined to the East.

The great majority of the forms recorded in the tables are undoubtedly peculiar to the Transition Zone. Only the following would seem to belong to the Canadian, or boreal fauna:

Myrmica brevinodis vars. *sulcinodoides, canadensis,* and *frigida,*
M. scabrinodis subsp. *lobicornis* var. *glacialis,*
Leptothorax acervorum subsp. *canadensis* and its vars. and the subsp. *crassipilis,*
L. muscorum and its vars.,
L. provancheri,
L. emersoni and its subspecies,
Stenamma nearcticum,
S. brevicorne, its subspecies and varieties,
Lasius niger var. *sitkaënsis,*
L. flavus subsp. *claripennis,*
L. umbratus subsp. *subumbratus,*
Formica bradleyi,
F. sanguinea and subsp. *subnuda* and *aserva,*
F. rufa obscuripes and its var. *melanotica,*
F. truncicola and its subspecies and varieties,
F. whymperi and its varieties,
F. dakotensis and its varieties,
F. ulkei,
F. fusca and its varieties *neorufibarbis, marcida, subaenescens, argentea, gelida* and *algida* and the subsp. *pruinosa,*
F. hewitti,
F. cinerea var. *altipetens* and *canadensis,*
F. neogagates, its subspecies and var. *vetula,*
Camponotus laevigatus,
C. herculeanus var. *whymperi* and subsp. *ligniperda* var. *noveboracensis.*

Most of these are what the Germans would call "stenotherm kälteliebend" (stenothermal psychrophilous). Some of them, however, and especially those common to the four regions of the tables, are

strikingly eurythermal ("eurythermal ubiquists" of Zschokke, 1907, 1908). A list of the latter would include the following:

Myrmica scabrinodis and most of its subspecies and varieties,
Aphaenogaster subterranea subsp. *occidentalis*,
Tapinoma sessile,
Prenolepis imparis,
Lasius niger subsp. *alienus* var. *americanus*,
L. brevicornis,
L. flavus subsp. *nearcticus*,
Formica sanguinea subsp. *rubicunda, subintegra* and *subnuda*,
F. fusca and its varieties *subsericea* and *argentea*,
F. cinerea var. *neocinerea*,
F. neogagates subsp. *lasioides* var. *vetula*,
Polyergus rufescens subsp. *breviceps*,
Camponotus herculeanus subsp. *pennsylvanicus*,
C. fallax var. *nearcticus*,
C. maculatus subsp. *vicinus* and its varieties.

It will be noticed that the bulk of the forms common to all four regions of the tables is made up of some eight of the forms included in this list. The ants of both the preceding lists, owing to their pronounced eurythermy or psychrophilous stenothermy, constitute the great majority of the forms common at higher elevations in the mountains of North America. Incidentally attention may be called to the high degree of melanism of nearly all the forms enumerated in these lists. This is a well-known peculiarity of many arctic-alpine insects (*Cf.* Zschokke, 1908, p. 42).

The ant-fauna of the Nearctic Transition and Boreal Zones as a whole shows very close affinities to the fauna of the corresponding zones of the Palearctic Region, as will be evident from a study of the following list in which the most closely allied forms of the two regions are arranged in parallel columns:—

Palearctic	*Nearctic*
Ponera coarctata	P. coarctata subsp. pennsylvanica
Monomorium minutum	M. minimum
Solenopsis fugax	S. molesta
Myrmica sulcinodis	M. brevinodis
M. scabrinodis var. sabuleti	M. scabrinodis var. sabuleti
M. scabrinodis subsp. lobicornis	M. scabrinodis subsp. lobicornis var. glacialis

Palearctic	*Nearctic*
M. scabrinodis subsp. schencki	M. scabrinodis subsp. schencki var. emeryana.
M. levinodis	M. levinodis subsp. neolevinodis
M. rubida	M. mutica
Leptothorax acervorum	L. acervorum subsp. canadensis
L. muscorum	L. muscorum var. sordidus
L. flavicornis	L. curvispinosus and rugatulus
Harpagoxenus sublevis	Harpagoxenus americanus
Formicoxenus nitidulus	Symmyrmica chamberlini
Stenamma westwoodi	Stenamma nearcticum
Aphaenogaster subterranea	A. subterranea subsp. occidentalis
Tapinoma erraticum	T. sessile
Bothriomyrmex meridionalis	B. dimmocki
Liometopum microcephalum	L. occidentale
Hypoclinea 4-punctata	H. plagiata
Prenolepis imparis subsp. nitens	P. imparis
Lasius niger	L. niger var. sitkaënsis and neoniger
L. niger subsp. alienus	L. niger subsp. alienus var. americanus
L. flavus	L. flavus subsp. nearcticus
L. umbratus subsp. mixtus	L. umbratus subsp. mixtus var. aphidicola
Formica sanguinea	F. sanguinea subsp. rubicunda
F. rufa subsp. pratensis	F. rufa subsp. obscuripes
F. truncicola	F. truncicola subsp. integroides
F. exsecta	F. exsectoides
F. fusca	F. fusca
F. cinerea	F. cinerea var. neocinerea
F. rufibarbis	F. rufibarbis var. occidua
Polyergus rufescens	P. rufescens subsp. breviceps
Camponotus herculeanus var. whymperi	C. herculeanus var. whymperi
C. herculeanus subsp. ligniperda	C. herculeanus subsp. ligniperda var. noveboracensis
C. herculeanus subsp. pennsylvanicus	C. herculeanus subsp. pennsylvanicus
C. fallax	C. fallax var. nearcticus
C. maculatus subsp. aethiops	C. maculatus subsp. vicinus
C. truncatus	C. impressus

In this list of 41 Nearctic forms 25 are specifically, 6 subspecifically and two varietally identical with Palearctic forms.

The results of the foregoing study of the Transition and Boreal ant-fauna agree in the main with those derived from other animals and of plants, and suggest the same problems as to the original source of the North American ant-fauna, the meaning of the differences between its western and eastern constituents and of the much greater richness of the former in species, subspecies and varieties. An intensive study of the geographical distribution of any circumscribed group of organisms necessarily involves an appeal to general historical considerations, since no group can be satisfactorily studied as an isolated unit. One is compelled, therefore, to assume an attitude towards certain hypotheses which have been gradually elaborated and are more or less firmly supported by the researches of many workers on many different groups. In assuming such an attitude one is inevitably more or less biased by the particular group or groups with which one is most familiar. Before considering the hypothetical centers of origin and the migrations of the various existing categories of insects and especially of the ants, it seems advisable to determine, if possible, the geological age of these categories. This has been attempted in three different ways: first, by a study of paleontology, second, by a study of present distribution on the supposition that forms with a wide and especially with a wide and discontinuous range are older than forms with a limited, continuous range, and third, by a combination of both of these methods. It is evident that the first method is of great importance, the second by itself of comparatively little value and open to many objections, and that the value of the third method depends largely on the paleontological facts to which it may be able to appeal. It is, however, the most comprehensive method and owing to the incompleteness of the paleontological record, the only one that can be resorted to in the study of many groups of organisms at the present time.

Our knowledge of fossil ants is rather limited but of great significance. The earliest known species are those of the Baltic amber, of Lower Oligocene age. Mayr (1868) and I (1914) have described nearly a hundred of these belonging to no less than 43 genera, 19 of which are extinct and 24 still extant, viz: *Ectatomma* (subgen. *Rhytidoponera*), *Euponera* (subgen. *Trachymesopus*), *Platythyrea*, *Ponera*, *Sima*, *Monomorium*, *Erebomyrma*, *Vollenhovia*, *Stenamma*, *Aphaenogaster*, *Myrmica*, *Leptothorax*, *Dolichoderus* (subgen. *Hypoclinea*), *Iridomyrmex*, *Liometopum*, *Plagiolepis*, *Gesomyrmex*, *Dimorphomyrmex*, *Oecophylla*, *Prenolepis*, *Lasius*, *Formica*, *Pseudolasius* and *Camponotus*.

From the Scilian amber, which is of later, Miocene age, Emery (1891) has described 14 ants representing 13 genera, 11 of which are still extant, viz: *Ectatomma, Ponera, Cataulacus, Podomyrma* (subgen. *Acrostigma*), *Aëromyrma, Crematogaster, Tapinoma, Technomyrmex, Plagiolepis, Gesomyrmex* and *Oecophylla.* Heer (1848, 1849) had previously described a number of ants from the Miocene shales of Oeningen and Radoboj, but owing to the imperfectly developed taxonomic categories of his day, referred them to such generalized genera as *Formica, Ponera* and *Myrmica.* Mayr (1867), however, examined many of Heer's types from Radoboj and was able to recognize among them representatives of the following modern or extant genera: *Aphaenogaster, Leptothorax, Liometopum, Dolichoderus* (subgen. *Hypoclinea*), *Lasius, Formica, Oecophylla* and *Camponotus.* Among several thousand ants from Florissant, Colorado, also of Miocene age, I am now able to recognize specimens belonging to the recent genera *Pheidole, Crematogaster, Aphaenogaster, Liometopum, Dolichoderus* (subgen. *Hypoclinea*), *Lasius, Formica* and *Camponotus,* in addition to a few extinct genera (e. g. *Agroecomyrmex*). It is evident, therefore, that a large number of important ant genera of the present had been developed by early Tertiary times, and as the species representing these genera are quite as highly specialized as their existing congeners, I believe that we must assume that their genera go back at least to the Basic Eocene or even to the Upper Cretaceous. And since these genera clearly represent four of the five subfamilies of living ants, and among them the most highly specialized subfamily, the Camponotinae, we are justified in assuming that the subfamilies of the Formicidae were differentiated during the Mesozoic, probably as early as the Jurassic or Triassic. This assumption is in general accord with the opinions of Emery (1893) and Handlirsch (1913). According to the latter "we know today that by the end of the Cretaceous all the main groups of insects had been completed, that the species living today arose not later than the Pleistocene and the majority of them in the Pleiocene and in certain cases go back even to the Oligocene. The present genera were certainly nearly all completed in the late Tertiary, many of them already in the Oligocene and perhaps some of them in the Upper Cretaceous." He believes (1909) that the Formicidae as a family could scarcely have originated before the Upper Cretaceous. I am inclined to believe that these estimates, at least as far as the ants are concerned, are too conservative. If I understand Emery correctly, his estimates are somewhat closer to my own, for he is inclined to assign the genera of the oldest subfamily,

the Ponerinae, and several Myrmicine genera to the Mesozoic, and many Dolichoderinae and Camponotinae to the early Tertiary. Kolbe (1913), however, comes still closer to my point of view in a very suggestive study of the distribution of certain ancient genera of Coleoptera, an order which can scarcely be much older than the Hymenoptera. He calls attention to the fact that if we compare the beetles of Australia and Europe we find that they possess no less than 146 genera in common, and that owing to the fact that Australia was isolated during the Eocene we are justified in regarding all such genera as of Mesozoic age. I believe that the same conclusion is admissible in the case of other insects and especially in regard to the ants and would hold good also of the genera common to Australia and America. In the following list, including all the known genera of Australian ants, the genera printed in large type are represented also in the Neotropical and Nearctic faunas and those preceded by an asterisk occurred in the Tertiary of Europe or are represented in the living fauna of that continent:

SPHINCTOMYRMEX
*CERAPACHYS
Phyracaces
Myrmecia
Amblyopone
*PLATYTHYREA
ACANTHOPONERA
Onychomyrmex
Paranomopone
Diacamma
*ECTATOMMA
Bothroponera
Odontoponera
*EUPONERA
*PONERA
Dorylozelus
Prodiscothyrea
Prionogenys
LEPTOGENYS
*ANOCHETUS
ODONTOMACHUS
Aenictus
Metapone
*Sima
*Oligomyrmex
Pheidologeton
*CREMATOGASTER
*SOLENOPSIS
*PHEIDOLE
Lordomyrma
*Vollenhovia
*Podomyrma
*MYRMECINA
Machomyrma
Dacryon
*MONOMORIUM
*CARDIOCONDYLA
*APHAENOGASTER
*TETRAMORIUM
Pristomyrmex
Triglyphothrix
Mayriella
ROGERIA
Prodicroaspis
Promeranoplus
Meranoplus

Calyptomyrmex
*STRUMIGENYS
*EPITRITUS
Orectognathus
Epopostruma
Rhopalothrix
*DOLICHODERUS (subgen. HYPOCLINEA)
Leptomyrmex
Frogattella
Turneria
*IRIDOMYRMEX
*BOTHRIOMYRMEX
*TAPINOMA
*Technomyrmex
Acropyga
*Plagiolepis
*Acantholepis (subgen. Stigmacros)
Prolasius
Melophorus
*Pseudolasius
Notoncus
*Oecophylla
Myrmecorhynchus
*PRENOLEPIS
Opisthopsis
Echinopla
Calomyrmex
*CAMPONOTUS
Polyrhachis

Of the 75 genera in this list 31 or 41.3% are known to exist or have existed in Europe and 27 or 36% in America; 37 or 49.3% are unknown in either of these regions, but more than half of them are represented in the Oriental region. As the migration of ants from the latter region into Australia since its isolation has been very much restricted, these genera must also be regarded as of Mesozoic origin. It should also be noted that 21 or 28% of the 75 Australian genera belong to the most ancient and primitive subfamily of the Ponerinae, a group comparable to the Monotremes and Marsupials among mammals and one which reaches no such proportions in any of the other geographical regions. I believe, therefore, that we have underestimated the antiquity of the genera of ants and that the great majority of them are of Pretertiary or at the latest of early Eocene development. The same may be true even of certain species of tropicopolitan or cosmopolitan distribution, e. g. *Solenopsis geminata*, *Odontomachus haematoda* and especially *Camponotus* (*Myrmoturba*) *maculatus*, which is represented by numerous local races and varieties not only on all the continents but also on many islands (*e. g.* Hawaii!). There are good reasons for believing, however, that the great majority of existing species and subspecies are of Postmiocene origin. In North America and Eurasia, at any rate, only subspecies and varieties seem to have developed since the Ice Age. This is indicated by the very small number of varieties common to the Nearctic and Palearctic faunas as compared with the number of common species and subspecies (see pp. 485–486).

Paleographers agree in characterizing the Upper Jurassic as a period of great continental emergence, warm climate and a cosmopolitan flora. During this and the ensuing Cretaceous most of the families and genera of insects, like the flora on which so many of them were vitally dependent, must have assumed their modern facies and have become very widely distributed. According to Osborn (1910, p. 95) the "most memorable fact about the flora is one recently insisted upon by Knowlton (1909), namely that as we pass from the Cretaceous into the Eocene there is no appreciable change in the flora. From this it would appear that there was no secular change of climate; that the temperature was the same." There is nothing to indicate that the insects underwent any profounder change than the plants, so that we are unable to believe that these animals exhibited anything like the catastrophic elimination which occurred in several other groups of organisms both terrestrial and aquatic at the end of the Cretaceous. There is therefore no justification for assuming a close parallel in the course of development of such insects as the ants during the Tertiary with that of the mammals, whose phylogeny during that period was very complicated and greatly accelerated. The repeated migrations of mammals between North America and Eurasia during Cretaceous and Posteocene time were probably paralleled by the ants but we have no precise evidence of such movements. A single land-bridge, the Siberian-Alaskan, which is accepted by all students of geographical distribution, and according to most of them was in existence during the Cretaceous and again from late Miocene to Pleistocene times, is sufficient to account for the present constitution of our North American ant-fauna. Scharff (1907, 1912) and others have adduced considerable evidence in favor of another land-bridge connecting North America with Great Britain and Scandinavia during Preglacial and early Glacial time, but others reject this construction though they have not succeeded in accounting for the fauna and flora of Greenland and Iceland and the distribution of many eastern Nearctic and western European forms on any other hypothesis. That there was a gradual cooling of the climate from late Eocene to the Glacial Epoch is also generally admitted and the resulting development of pronounced zonal climates had a very powerful effect, as we know, on the fauna and flora of the northern hemisphere. The elimination of species thus induced over the area covered by the great ice-sheet both in Europe and North America and the southward migration of surviving species away from its border have been so often discussed that I need not dwell on them here. The ants of the

Baltic amber and of Florissant, like the plants of the same formations, show very clearly the gradual cooling of climate during the early and middle Tertiary. In the latitude of Sweden, where the amber was formed, the climate seems to have been subtropical as early as the Lower Oligocene, since the ants belonging to boreal genera such as *Formica, Lasius, Prenolepis s. str.* etc. constitute a dominant component of the fauna, at least in individuals. During the Miocene the climate of Colorado, as indicated by the Florissant plants, resembled that of the Gulf States at the present time. The ants perhaps indicate a slightly cooler and dryer climate, not unlike that now prevailing at low altitudes in Colorado or New Mexico.

I am inclined to believe, with Scharff, that the extent of the southward migration or displacement of organisms beyond the border of the ice sheet during glacial times has been exaggerated by many authors. Still there must have been some displacement and considerable extinction. It is at any rate clear that owing to the absence of such a complete barrier to southward migration as the Alps and the Mediterranean, our North American fauna suffered much less severely during the Ice Age than that of Europe. Moreover our fauna has been greatly enriched since the Pleistocene by a northward immigration of numerous neotropical species into the Southern United States by way of Mexico and the West Indies. The neotropical immigrants among ants belong to the Doryline genus *Eciton,* to several Ponerine genera (*Neoponera, Pseudoponera, Ectatomma, Leptogenys* and *Odontomachus*), to several Myrmicine genera (*Pseudomyrma, Cryptocerus, Macromischa, Xenomyrmex, Xiphomyrmex,* possibly *Pogonomyrmex* and especially to the fungus-growing tribe Attini (*Atta, Acromyrmex, Trachymyrmex* and *Cyphomyrmex*), to the Dolichoderine genera *Forelius, Dorymyrmex* and *Iridomyrmex* and to the Camponotine genera *Brachymyrmex, Prenolepis* (subgen. *Nylanderia*) and *Camponotus* (subgen. *Myrmothrix, Myrmobrachys* and *Myrmamblys*). Some of these genera (*Pseudoponera, Odontomachus, Leptogenys, Iridomyrmex*) are common to paleotropical regions and at once suggest the question as to whether they originally reached South America during the Cretaceous by way of Antarctica from Australia or came from Asia by way of North America or over other land-connections from other parts of the Old World, and therefore involve a discussion of the hypothetical southern land-bridges, which several recent writers, notably H. von Ihering and Scharff, have been very actively constructing in order to explain certain cases of wide and discontinuous distribution among organisms. So far as the Formicidae are concerned I

unreservedly agree with those who repudiate all such connections, with the exception of the Siberian-Alaskan and possibly the North Atlantic bridges. I am quite unable to find anything in the neotropical ant-fauna that makes it necessary to assume former connections of South America with Australia or with Africa. The only genus supposed to be peculiar to Australia and South America is *Melophorus*, which is represented by numerous species in the former region and to which Forel and Emery referred a few Chilian and Patagonian species formerly regarded as belonging to the holarctic genus *Lasius*. But Emery later showed that the Chilian and Patagonian forms really constitute a distinct subgenus, which he called *Lasiophanes*. From a recent study of the Australian species I am convinced that they should be generically separated from the South American species. So far as Africa and South America are concerned, they have no genera in common which have not a much wider distribution in the Palearctic or Oriental regions.

Among the numerous writers on geographical distribution who have recently rejected or ignored the speculations of the bridge-builders, I will consider only Kolbe, Handlirsch and Matthew, as they seem to me to have reached conclusions very similar to those suggested by my study of the Formicidae. These writers recall those who, like Allen (1878), Scribner (1882) and Haacke (1887) long ago pointed to the north polar region as the original center of organic distribution, but differ in placing this center in Central or Eastern Asia. Kolbe (1913) calls attention to the vast extent and great permanence of the Asiatic continent during geologic time as contrasted with Europe and selects the region between the Caspian Sea and Eastern China, and especially Turkestan and Thibet, as the most ancient of the sources and reservoirs of Palearctic animal life. This is indicated by both the mammals and the insects. Of the single beetle genus *Carabus* Central Asia alone possesses 35 endemic subgenera! Europe is merely a zoögeographical appendix of Asia, to which the African, Australian and North American faunas are easily traceable by emigration during the Cretaceous when there existed a broad Siberian-Alaskan land-bridge.

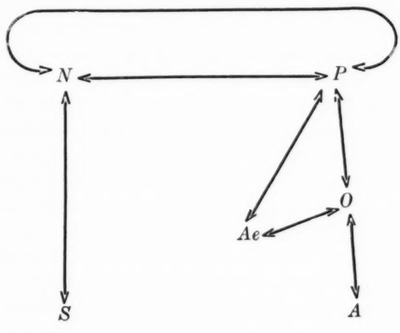
Kolbe does not discuss the origin of the neotropical fauna nor the antarctic and other land-bridges, but Handlirsch (1913) comes to close grips with these constructions in a valuable statistical study of more than 16,000 insect genera, comprising 180,000 species or about one third of the known forms. His results in regard to the distribution of the endemic as contrasted with the more widely distributed genera in the various geographical regions are given in the following interesting table:

	Total of Genera	a. Endemic Genera	b. More widely distributed Genera	Ratio a to b
Neotropical	5617	3437	2180	1:0.63
Nearctic	3467	797	2670	1:3.35
Palearctic	4956	1859	3097	1:1.67
Ethiopian	3968	2249	1719	1:0.76
Oriental	4137	1641	2496	1:1.52
Australian	3101	1400	1701	1:1.21

Of Wallace's regions, the Neotropical, owing to its very large proportion of endemic genera, is therefore the most independent and best established, the Nearctic the least. In an examination of 8300 selected genera, Handlirsch finds that only about 4% have a discontinuous distribution and would therefore constitute the chief basis for the contentions of the bridge-builders. But it appears that the generic relations between the Neotropical and Ethiopian regions, for which von Ihering constructed his "Archhelenis" land-bridge, are actually feebler than those between the Neotropical and Oriental, or between the Nearctic and Oriental or between the Palearctic and Australian! Furthermore, the Neotropical is really more closely related to the Palearctic than to the African insect fauna. These facts are clearly brought out in the following numbers of genera found to be common to the different regions, after excluding the cosmopolitan species:

Palearctic and Nearctic	1225
Nearctic and Neotropical	1159
Palearctic and Oriental	1083
Oriental and Australian	754
Oriental and Ethiopian	701
Palearctic and Ethiopian	687
Palearctic and Neotropical	571
Palearctic and Australian	472
Nearctic and Oriental	306
Neotropical and Oriental	259
Ethiopian and Australian	327
Neotropical and Australian	228
Neotropical and Ethiopian	195
Nearctic and Australian	197
Nearctic and Ethiopian	159

The study of such a circumscribed group as the Formicidae would be even more unfavorable to the views of von Ihering and other bridge-builders than the more comprehensive studies of Handlirsch, because the relationships of the ants of South America to those of Africa or Australia would be represented, as I have stated, only by genera of cosmopolitan range or at any rate common to the Palearctic and Oriental regions, from which they could have found their way to the New World over the Behring Sea and North Atlantic land-bridges. Handlirsch summarizes his views on the migrations of forms between the different regions in the following simple diagram, in which *S* stands for the Neotropical and *Ae* for the Ethiopian region:



Matthew (1915) has reached very similar conclusions from a study of the distribution of Vertebrates and particularly of the mammals. He finds the same fallacies as Handlirsch in the work of the bridge-builders and expresses them in the following paragraphs:

"1. The discontinuous distribution of modern species is again and again taken as proof that the regions now inhabited must have been connected across deep oceanic basins, without considering the possibility that it is a remnant of a wider past distribution, or that it is due to parallel evolution from a more primitive type of intermediate distribution, now extinct. Yet so many instances are known where the geological record has furnished proof that one or the other of these explanations applies to cases of discontinuous distribution, that it would seem that these ought to be the first solutions of the problem to be considered, and that in view of the known imperfection of the

geologic record, mere negative evidence is not sufficient to cause them to be set aside.

"2. No account is taken of faunal interchanges often much more extensive, which would presumably have taken place if the land-bridges assumed had existed, but which have not taken place. It may here be urged that this too is negative evidence. But the negative evidence derived from an appeal to the geological record is weak, not *per se*, but because of the demonstrated imperfection of the record. On the other hand, there are many instances where a land-bridge is well proven, and in these cases it is not a few scattered exceptions, but an entire fauna that has migrated, subject only to the restrictions imposed by climatic or topographic barriers of other kinds."

In accounting for the present discontinuous distribution of many ancient and primitive forms Matthew seems to me to have made good use of a principle which seems to have been first suggested by Haacke (1887). This writer called attention to the fact that at the present time the most primitive types of the various groups of animals are mostly confined to the tropics and the southern hemisphere. This can be most readily explained on the supposition that the situations in which such forms now live are not their original habitats but those to which they have been relegated by more recent and more specialized forms evolving and usurping their places in the territory originally occupied by the group. Hence the oldest and most primitive members of a group come to be found today at the periphery of its range and the more recent and specialized forms in or near its center. Clark (1915) has reached the same conclusion from his study of the distribution of the Onychophora. He says: "Any animal type, once evolved, will extend itself immediately in every direction as far as the natural barriers to its dispersal; a more specialized form (a dominant type) of the same animal, better fitted for the conditions under which it lives, will sooner or later be evolved somewhere in the central, or more favorable portion of the territory inhabited by the original type; this new type will at once extend itself as did the original type; but in the meantime there may have arisen certain barriers, which the second type cannot cross and beyond which, therefore, the first type is secure. Up to these barriers — high mountains, deserts, newly formed arms of the sea, or whatever they may be — the second type will gradually supplant the first, as a result of its better economic equipment and more perfect physical resistence, and the advantage which this better equipment and resistance give it in the struggle for existence. Thus we shall eventually find a specialized type beyond

the limits of which occurs a more generalized type of the same organism. The subsequent evolution of additional types, which will most frequently occur at or near the so-called center of distribution as a natural result of the greater facility for adaptation due to the greater distance apart of the physico-economic barriers and the consequently greater radius of each type, will result in the gradual formation of a dispersal figure which would be ideally represented by a series of concentric circles, each of the circles representing a barrier, the small central circle enclosing the most perfected type and the peripheral band the most generalized, the intervening areas including intermediate types increasing in specialization toward the center."

The Formicidae show in a very striking manner the relegation of the most primitive forms to the tropics and southern hemisphere and especially to the Neotropical, Oriental and Australian regions. As all of these forms are exquisitely thermophilous and stenothermal, whereas the Palearctic and Nearctic faunas and particularly the forms peculiar to the mountains consist of more specialized, stenothermal and psychrophilous species together with a small number of eurythermal ubiquists, we are led to believe that the development of zonal climates during the Tertiary has been the essential factor in determining the distribution of the present world-wide distribution of ants. The mountain faunas are therefore of comparatively recent origin and this is particularly true of that of the Rocky Mountains, to judge from the large number of subspecies and varieties, most of which have, in all probability, developed since the Pleistocene. The Rocky Mountains as an independent center of formation of new forms contrast markedly with the Alps and Himalayas, for there are relatively few ants peculiar to the latter and especially to the Alps. This may be attributed to geological conditions. Geologists maintain that the Rocky Mountains began to be elevated as early as late Cretaceous time and by the Eocene had attained altitudes of 4000 to 5000 feet. They continued to rise during the Tertiary Period to altitudes of 13,000 to 14,000 feet, with a corresponding elevation of the bases between them and considerable erosion of their summits. The Alps however, did not appear till the close of the Oligocene and only during the Miocene were the Himalayas uplifted. The Alpine area, moreover, was surrounded by water till the Miocene when it became joined by a broad land-connection with Central Asia. Its connection with France by means of another land-connection is said to have occurred at the end of the Miocene. These conditions, together with the later extensive glaciation of the Alps, must have been very potent factors

in preventing the development of an indigenous ant fauna. On the other hand the Rocky Mountains occupy a very large area and were much less affected by the unfavorable climate of the Ice Age. They therefore remained as a preserve of Pleiocene species and during more recent times became a center of origin of many races and varieties. For evidence in support of this contention we have only to compare the Nearctic and Palearctic forms of the genera *Myrmica, Leptothorax, Lasius, Formica, Polyergus* and *Camponotus*.

I advanced the opinion that the Rocky Mountains were probably the center of origin of the genus *Formica* in my paper on this group (1913), but I now accept Handlirsch's view that not only the genus *Formica,* but the whole family Formicidæ had its origin during the Mesozoic in Eurasia and believe, with Kolbe, that Central or Eastern Asia is, as seems to be the case with so many other groups of organisms, the most likely spot in which to seek the origin of the ants. The views of Matthew and Clark on the development of the specialized forms in the center of the geographical range of a group and the relegation of the older and more primitive forms to the periphery of that range, appear at first sight to support my former contention, but it now seems to me to be more probable that the Rocky Mountains constitute only a secondary, more recent center of speciation, and that they are much more important as a region of conservation. It may be noted in this connection that Japan is evidently a similar secondary center of speciation for the same genera, since in that country the common holarctic species of *Myrmica, Lasius, Formica, Polyergus* and *Camponotus* have developed several peculiar subspecies and varieties. The same is true of the Eastern United States, which are also characterized by the development of endemic forms of *Myrmica, Formica,* etc.

This brings us, finally, to the problem with which we started, the pronounced difference between the ant faunas of western and eastern North America, a difference very similar to what has been so often noticed in other groups of organisms. It may be readily attributed to a difference in survival after the glaciation of the northern portion of the continent, since the ice-sheet is known to have advanced considerably further south in the eastern than in the western half of the continent, while the Gulf of Mexico formed an impassable barrier to a directly southward emigration of species. Hence we should expect a much more meager survival of species in the Eastern than in the Western United States. The differences of character in the endemic forms of the two regions, however, must be due to other conditions, some of which were undoubtedly preglacial, while others were as clearly

postglacial. If we may judge from the Florissant deposits, the North American ant-life of Miocene times was poorer in species than that of Europe, but we must bear in mind that the Florissant locality is a very limited and elevated area and that the preserved ants are nearly all males and females which happened to fall into a small lake during their nuptial flight and after sinking to the bottom became embedded in volcanic sediment. Many of the species became extinct, but some of them, notably those of the genera *Aphaenogaster, Lasius* and *Liometopum,* were undoubtedly very closely related to forms of the same genera still living in Colorado. To the descendants of this Miocene fauna there was added during the Pleiocene a number of forms by immigration from Asia over the Siberian-Alaskan land-bridge, probably at the same time and by the same route as the Strepsicerine and Hippotragine antelopes. Probably, too, certain North American ants passed into Asia at the same time, just as seems to have been the case with the camels. Emery has recorded the occurrence of *Camponotus herculeanus* subsp. *pennsylvanicus* in Siberia and Burmah, and the closely related *C. japonicus* was originally described by Mayr as a mere variety of that subspecies. Probably such species as *Aphaenogaster subterranea, Myrmica lobicornis, Leptothorax muscorum,* some form of the subgenus *Neomyrma* closely related to the Eurasian *rubida* and the ancestor of *N. mutica, hunteri* and *aldrichi,* together with several species of *Formica,* notably *cinerea, rufibarbis, rufa, truncicola* and *Polyergus rufescens,* first entered North America during the Pleiocene. Even at the present time few of these species have succeeded in extending their range to the Atlantic States. The origin of the peculiarly eastern forms is more obscure. Probably a number of them are Mesozoic and early Tertiary survivors, notably the Ponerinae, and the species of *Strumigenys, Myrmecina* and *Aphaenogaster.* Others may have come from Europe over the North Atlantic land-bridge during the late Tertiary and have given rise to such forms as *Formica ulkei, exsectoides,* and *pallidefulva* and *Camponotus castaneus.* Some of these have migrated westward as far as the easternmost ranges of the Rocky Mountains but none has reached the Pacific Coast Eurythermal ubiquists like *Tapinoma sessile, Prenolepis imparis* and *Formica fusca* may have existed in North America since the Oligocene or Eocene. *F. fusca* and *P. imparis* are, as I have shown (1914), almost identical with *F. flori* and *P. henschei* of the Baltic amber. That elements derived from such various sources and migrations, probably separated by long periods of time, should have gradually evolved a number of subspecies and varieties in the localities to which

they were at first confined, is only what might be expected. And that such varieties and subspecies should be much more numerous in the Rocky Mountains than in the Eastern States is also to be expected, when we consider the much greater variety of physical conditions in that region. The high mountains running north and south through many degrees of latitude, with very high timber and snow lines and often broken into isolated ranges separated by arid basins or "parks," sometimes of great extent, constitute a much more favorable territory for the production of endemic races and varieties than the compact east and west massif of the Alps with their low timber and snow lines and narrow valleys. Some very short mountain ranges, especially in Arizona, New Mexico and Western Texas are, in fact, quite insular, being completely surrounded by the desert from which they rise, and like islands have developed numerous endemic, or precinctive forms. This is very clearly seen in the Huachuca Mountains of Arizona, which are inhabited by several ants and other insects not known to occur in any other localities. The Coast Range and Sierra Cascade Ranges have also each developed a number of endemic forms. Unfortunately we are unable at the present time to appreciate the precise character and extent of this endemicity in our western mountains, because our knowledge of the distribution of any single insect group in any one of the various ranges is very fragmentary. This is equally true of the Appalachian System (White Mountains, Adirondacks, mountains of North Carolina and Georgia). Certainly no more interesting work could be undertaken by our taxonomic entomologists than a detailed and systematic survey of the various groups of insects in all these ranges after the manner of the fine surveys of the distribution of vertebrates and woody plants by Dr. C. H. Merriam and his collaborators.

List and Descriptions of Western Mountain Ants.

Myrmicinae.

1. *Monomorium minimum* Buckley.

The typical form of this species, which is common in Texas and the Atlantic States at lower elevations and south of New England, has been taken by Prof. C. F. Baker in Ormsby County, Nevada, on the eastern shore of Lake Tahoe. I have found it in Arizona and Colorado and Dr. W. M. Mann collected it in the mountains of Hidalgo, Mexico.

2. *Monomorium minimum* subsp. *ergatogyna* Wheeler.

Known only from Catalina Island, Cala., where it was taken several years ago by Prof. C. F. Baker.

3. *Monomorium minimum* subsp. *compressum* Wheeler.

Taken by Dr. W. M. Mann at Guerrero Mill, Hidalgo, Mexico.

4. *Monomorium minimum* subsp. *cyaneum* Wheeler.

A beautiful metallic blue form from the same locality as the preceding.

5. *Solenopsis molesta* Say.

The typical form of this species is abundant throughout the Eastern United States and Southern Ontario. It occurs also, but more sporadically, in the mountains of Colorado and New Mexico at altitudes below 8000 ft.

6. *Solenopsis molesta* var. *validiuscula* Emery.

Originally described from Los Angeles and San Jacinto, California. I have taken it in the Santa Inez Mts. near Santa Barbara in the same state, and Dr. Mann has give me specimens which he collected at Wawawai, Washington.

7. *Solenopsis molesta* var. *castanea* Wheeler.

A dark color variety originally described from Woodland Park, in the Ute Pass, Colorado (Wheeler).

8. *Myrmecina graminicola* Latr. subsp. *americana* Emery.

A rather rare ant, occurring in rich, shady woods in the Eastern States and as far west as Texas and the Grand Canyon, Arizona.

9. *Myrmecina graminicola* subsp. *americana* var. *brevispinosa* Emery.

In distribution this form is similar to the preceding. I have taken it as far west as New Braunfels, Texas, and have seen specimens collected by Mr. E. S. Tucker at Plano in the same state.

10. *Myrmecina graminicola* subsp. *texana* Wheeler.

Known only from Austin, Texas, where I found it many years ago in moist places in the canyons of the Edwards Plateau.

11. *Myrmica brevinodis* Emery.

The typical form of this species is common in the Transition Zone of Colorado, about Colorado Springs, Denver, Boulder, Buena Vista, etc.

12. *Myrmica brevinodis* var. *brevispinosa* Wheeler.

Known from New Mexico and Colorado.

13. *Myrmica brevinodis* var. *frigida* Forel.

The types of this variety were taken by Whymper in the Ice River Valley, British Columbia (5000 ft.).

14. *Myrmica brevinodis* var. *sulcinodoides* Emery.

British Columbia: Hector, Carbonate and Spillimachen R., Selkirk Mts. (C. J. Bradley); Field and Yoho Pass, Emerald Lake (Wheeler).

Alberta: Lake Louise (Wheeler).

Colorado: Rico, 10,000 ft. and Hayden Peak, 10,000 ft. (E. J. Osler); Boulder and Ward (W. W. Robbins); Lost Lake, Eldora, 9500 ft. (D. M. Andrews).

California: Lake Tahoe, 6000 ft. (Wheeler).

This variety is so much like the typical European *M. sulcinodis* Nyl. that one is inclined to regard *brevicornis* as merely a subspecies. The form described by Forel as *brevinodis* var. *whymperi* from Vermilion Pass, Alberta, is, so far as I am able to judge from two cotypes received from Prof. Forel, merely *sulcinodoides*. For a description and further citations of localities of this variety from Utah, Colorado and New Mexico, see my revision of the forms of *brevinodis* in Bull. Wis. Nat. Hist. Soc. 5, 1907, p. 73 *et seq.* The workers from Lake Tahoe have the epinotal spines rather short and perceptibly curved downward at the tips. It does not seem desirable to regard them as representing a distinct variety.

15. *Myrmica brevinodis* var. *decedens* Wheeler.

Colorado: Buena Vista, 7900 ft. (type locality) and Florissant, 8500 ft. (Wheeler).

New Mexico: Pecos Mts., San Miguel County (Mitchell).

The workers from New Mexico are considerably darker than the types and may prove to belong to a distinct variety.

16. *Myrmica brevinodis* var. *alaskensis* var. nov.

Worker. Length 3.5 mm.

Resembling the variety *sulcinodoides* but smaller and of a different color. Head black above; thorax, pedicel and gaster castaneous; mandibles, antennae and legs brownish yellow. Antennae slightly thicker at the base than in *sulcinodoides*. Rugae on the clypeus very coarse, much fewer in number (only 8) than in other forms of the species; frontal area distinctly outlined, subopaque and very finely punctate, not longitudinally rugulose. Rugae on the sides of the head coarsely reticulate, not longitudinal, those on the thorax and pedicel much as in *sulcinodoides* but a little finer; surface of head, thorax and pedicel a little more opaque. Epinotal spines somewhat shorter than the base of the epinotum, curved downward at their tips. Summit of petiolar node distinctly more rounded than in *sulcinodoides* and transversely rugose, postpetiolar node less convex behind. Pilosity like that of *sulcinodoides*.

Described from eight workers taken at Seward, Alaska by Mr. F. H. Whitney.

17. *Myrmica brevinodis* var. *subalpina* Wheeler.

British Columbia: Hector, Field and Carbonate (J. C. Bradley); Emerald Lake (Wheeler).

Alberta: Banff (Wheeler); Jasper (C. G. Hewitt).

Washington: Orcus Island (W. M. Mann).

This variety, originally described from Florissant, Colo., forms flourishing colonies under logs and stones in moist, sunny places. I found it very abundant on the southern slope of Tunnel Mt. at Banff. It closely resembles the eastern var. *canadensis* Wheeler, but the wings of the male and female are whitish hyaline throughout and not infuscated at the base. The workers of certain colonies present transitions in color to the var. *sulcinodoides*, but this forms smaller colonies and prefers higher elevations.

18. *Myrmica mexicana* Wheeler.

This species, related to our eastern *M. punctiventris* Roger, was taken by Dr. Mann at Guerrero Mill, Hidalgo, Mexico.

19. *Myrmica scabrinodis* Nyl. subsp. *lobicornis* Nyl. var. *glacialis* Forel.

Alberta: Vermilion Pass, type locality (Whymper); Lake Louise and Moraine Lake, Valley of the Ten Peaks (Wheeler).

British Columbia: Emerald Lake (Wheeler); Carbonate and Prairie Hills, Selkirk Mts. (J. C. Bradley).

Montana: Helena (W. M. Mann).

Utah: Salt Lake County (R. V. Chamberlin).

Colorado: Florissant, Ute Pass, Cheyenne Canyon and Manitou (Wheeler); Creede Co. 8844 ft. (S. J. Hunter); Boulder (P. J. Schmitt); Pikes Peak, 10,000 ft., Willow Creek and West Cliff, 7864 ft. (T. D. A. Cockerell).

New Mexico: Harvey's Ranch, Las Vegas Range, 10,000 ft. (E. L. Hewett); Beulah, 8000 ft. (T. D. A. Cockerell).

Arizona: San Francisco Mts., 13,000 ft. (W. M. Mann); Coconino Forest, Grand Canyon (Wheeler).

Forel described this form from worker specimens as a variety of the typical *scabrinodis*, but has more recently placed it under the subsp. *schencki* Emery. During the summer of 1915 I found the males and females in many nests in British Columbia and Alberta and these phases show unmistakably that *glacialis* must be regarded as a form of *lobicornis*, a subspecies common in the Alps and Northern Europe but not hitherto known to occur in America. The antennal scapes of the male *glacialis* are strongly bent at the base and fully $\frac{2}{5}$ as long as the funiculus. They are therefore only a little shorter than in typical *lobicornis*. The other differences are equally insignificant. The *glacialis* male is a little smaller and has somewhat shorter epinotal teeth, the sculpture of the head and thorax is somewhat feebler so that the surface is more shining. The female is also somewhat smaller than the female of the typical form, its head and thorax are more shining and less coarsely sculptured, and the thorax and pedicel are darker, the angles at the base of the antennal scapes decidedly smaller. The worker specimens from the Grand Canyon, San Francisco Mts. and Boulder have the antennal lobes large and more flattened, much as in the typical *lobicornis*. The specimens from Helena are considerably paler and colored like the eastern *sabuleti*, but the greater length of the antennal scape in the male shows that they should be placed with *lobicornis*, although they may represent a distinct variety.

20. *Myrmica scabrinodis* subsp. *schencki* Emery var. *tahoënsis* var. nov.

Worker. Length 3.3–4 mm.

Small; antennal scapes geniculately bent at the base and at the flexure with a small rounded lobe, appearing as an acute tooth when the scape is seen from the side. Frontal area very distinct, triangular. Frontal carinae large, lobular. Epinotal spines slightly shorter than the base of the epinotum, as long as their distance apart at the base, rather slender, distinctly curved downwards at their tips. Petiole in profile blunt and rounded above.

Head, thorax and pedicel very coarsely and in the main longitudinally rugose, the surface subopaque; frontal area opaque, finely and densely longitudinally rugulose; concavity of epinotum smooth and shining like the gaster.

Hairs rather long, abundant and suberect on the body and legs as in the typical *schencki* var. *emeryana* Forel.

Head and gaster black; mandibles, antennae, thorax, petiole and post-petiole deep brownish red; legs slightly more yellowish red.

Female (deälated). Length 4.5–5 mm.

Very similar to the worker; pronotum transversely, mesonotum and scutellum strongly, pleurae more feebly longitudinally rugose; petiole and postpetiole longitudinally rugose above, densely and finely punctate on the sides and below as in the worker. Color like that of the worker, except that the thoracic dorsum and some spots on the pleurae are black.

Male. Length 3.5–4 mm.

Antennae very short, the scapes especially, which are feebly bent at the base and not more than three times as long as broad and shorter than the three basal funicular joints together; club 4-jointed. Frontal area large, distinct, triangular. Sculpture and pilosity much as in the var. *emeryana.* Color dark piceous brown; head black; mandibles, tarsi and articulations of legs brownish yellow; palpi whitish. Wings pale hyaline throughout, not infuscated at the base as in *emeryana.*

Described from numerous workers, several males and two females from several localities about Lake Tahoe (Tallac, Angora Lake, Glen Alpine Springs, Fallen Leaf Lake). The colonies are small and nest under stones in shady places.

21. *Myrmica scabrinodis* subsp. *schencki* var. *monticola* var. nov.

Worker. Length 3–3.5 mm.

Differing from the vars. *emeryana* and *tahoënsis* in its smaller size, in color and in the shape of the antennal scapes, which are rectangularly bent at the base and furnished at the flexure with a large, rounded,

shovel-shaped, transverse lobe, which is prolonged as a low membranous ridge for a short distance along the posterior edge of the joint. Frontal carinae suberect; frontal area small but distinct, triangular. Epinotal spines shorter than the base of the epinotum and than their distance apart at the base, straight, slender and acute. Sculpture of the mandibles, head, thorax and pedicel sharp but rather loose and the punctuation of the interrugal spaces very shallow, so that the surface is much more shining than in the other varieties of *schencki*. Rugae of the pro- and mesonotum very coarse, vermiculate, indistinctly longitudinal. Middorsal portion of postpetiole rather smooth and shining, somewhat as in the var. *detritinodis* Emery.

Pilosity rather long, abundant, coarse, erect and blunt on the body, appressed on the legs.

Color brownish yellow; scapes and legs of a clearer, paler yellow; head more brownish above; first gastric segment dark brown.

Male. Length 3.8–4.9 mm.

Antennae much as in the var. *tahoënsis*, the scape being distinctly shorter than the three basal funicular joints together. Surface of body shining, feebly sculptured; head finely and densely punctate, with indistinct rugae; the rugae on the thoracic dorsum also very faint. Protuberances of epinotum very blunt.

Color brown; head darker; mandibles, thoracic sutures, margins of gastric segments, antennal clubs, legs and tarsi, except the middle portions of the femora and tibiae, brownish yellow.

Described from a dozen workers and nine males taken by myself at Buena Vista, Colorado.

This is a very distinct form, which in the larger lobe of the antennal scapes approaches the typical European *schencki* more closely than do either of the varieties *tahoënsis* or *emeryana*. There are, however, in the Eastern States one or more large, dark, undescribed varieties which have a similar extensive antennal lobe.

22. *Myrmica* (*Neomyrma*) *bradleyi* Wheeler.

California: Glacier Point, Yosemite, 8000 ft. and Tallac, Lake Tahoe 6000 ft. (Wheeler).

This form was recently redescribed by Forel as *Aphaenogaster* (*Neomyrma*) *calderoni* from specimens taken by Calderon in the Lake Tahoe region. The types were taken by Prof. J. C. Bradley in Alta Meadow, Tulare Co., Cala., at an altitude of 9500 ft. It nests under stones in rather dry, sunny places and in habits closely resembles *M.* (*N.*) *mutica* Emery. The localities for this and two other species are here

transcribed from my recent paper on the American species allied to *M. rubra* Latr. (Psyche, 21, 1914, pp. 118–122).

23. *Myrmica* (*Neomyrma*) *mutica* Emery.

Colorado: Denver; type locality (E. Bethel); Colorado Springs, Salida, Buena Vista and Wild Horse, 6000–7000 ft. (Wheeler); Canyon City (Rev. P. J. Schmitt).

New Mexico: (Ern. André).

Utah: Salt Lake County (R. V. Chamberlin), as the host of the peculiar xenobiotic ant, *Symmyrmica chamberlini* Wheeler.

Washington: Olympia (T. Kincaid); Ellensburg and Pullman (W. M. Mann).

Alberta: McLeod (C. G. Hewitt).

British Columbia: Dog Lake, Penticton (C. G. Hewitt).

24. *Myrmica* (*Neomyrma*) *aldrichi* Wheeler.

Idaho: Moscow (J. M. Aldrich).

25. *Myrmica* (*Neomyrma*) *hunteri* Wheeler.

Montana: Madison R. near Beaver Creek, 7500 ft. (S. J. Hunter).

26. *Leptothorax andrei* Emery.

Originally described from California. I possess several workers taken by Dr. W. M. Mann at Palo Alto in that state.

27. *Leptothorax eldoradensis* Wheeler.

Taken on Mt. Wilson near Pasadena by Prof. J. C. Bradley.

28. *Leptothorax schmitti* Wheeler.

Known only from Canyon City, Colo.

29. *Leptothorax neomexicanus* Wheeler.

Described from Manzanares, New Mexico.

30. *Leptothorax nitens* Emery.

Known from Utah, California and Colorado.

31. *Leptothorax nitens* var. *heathi* Wheeler.

Known only from California.

32. *Leptothorax nitens* var. *mariposa* var. nov.

Worker. Resembling the var. *heathi* in being brown, with yellow legs and antennae, but the thorax is opaque and densely punctate

throughout, like the petiole and postpetiole. The punctures are decidedly coarser than in this variety and the typical form. The tips of the antennal scapes nearly reach the posterior corners of the head, being separated from them only by a distance equal to the greatest transverse diameter of the scape.

Several workers found nesting under the edges of stones in dry places in Tenaya Canyon, Yosemite Valley, Cala.

33. *Leptothorax nitens* subsp. *occidentalis* Wheeler.

Described from Friday Harbor, Washington.

34. *Leptothorax melanderi* Wheeler.

Taken on Moscow Mt., Idaho by Prof. A. L. Melander.

35. *Leptothorax furunculus* Wheeler.

Taken in Williams Canyon, near Manitou, Colo. at an altitude of 7500 ft.

36. *Leptothorax tricarinatus* Emery.

Described from a single worker specimen taken by Pergande at Hill City, South Dakota. I have not been able to recognize it among my specimens of *Leptothorax*.

37. *Leptothorax nevadensis* Wheeler.

Described from King's Canyon, Ormsby County, Nevada, where it was taken by Prof. C. F. Baker. This locality is on the eastern shore of Lake Tahoe.

38. *Leptothorax nevadensis* subsp. *rudis* subsp. nov.

Worker. Length 2.6–3.3 mm.

Distinctly larger and more robust than the typical *nevadensis* and much more coarsely sculptured. Funicular joints 2–8 distinctly broader in proportion to their length. Head subopaque, finely and densely longitudinally rugose, with punctate interrugal spaces and sometimes with an interrupted shining median line. Frontal area shining, very finely striated. Mandibles coarsely punctate, striated at their bases. Thorax and petiole coarsely punctate-rugose, the rugae on the pleurae and often also on the pro- and epinotum longitudinal, on the mesonotum often vermiculate. Declivity of epinotum densely punctate and as opaque as the remainder of the thorax (more shining in the typical form). Postpetiole densely punctate and opaque. The epinotal spines are much stouter and blunter, and the petiolar

node is much less compressed anteroposteriorly, its posterior surface being much more convex than in typical *nevadensis*. The color is considerably darker, the body being castaneous, with the head and gaster, except its incisures, blackish, the mandibles, clypeus, antennae and legs yellowish brown, the femora infuscated in the middle. Pilosity as in the typical form.

Female (deälated). Length: 3.5 mm.

Smaller than the female of typical *nevadensis*, with longer and more slender epinotal spines and the funicular joints 2–8 shorter. Sculpture of the head, thorax and petiole a little coarser. Petiolar node like that of the worker. In the typical form it is much compressed anteroposteriorly and has a sharp, transverse superior border. There is very little difference in color between the two forms.

Described from numerous workers and a single female taken from small colonies nesting under the edges of stones in Tenaya Canyon, Yosemite Valley, Cala. Seven workers from Angora Peak, 8600 ft., near Lake Tahoe, Cala., though differing in certain details of sculpture are nevertheless referable to this subspecies.

39. *Leptothorax rugatulus* Emery.

South Dakota: (Rergande).

Colorado: (Pergande); Cheyenne Canyon, near Colorado Springs (Wheeler).

Washington: Seattle (T. Kincaid).

Montana: Helena (W. M. Mann).

Study of much more material of this form and its varieties than I possessed when I wrote my "Revision of the North American Ants of the Genus Leptothorax" (Proc. Acad. Nat. Sci. Phila., 1903, pp. 215–260) convinces me that *rugatulus* is really a distinct species, as Emery maintained, and not a subspecies of *curvispinosus* Mayr. The latter is the most generally distributed and abundant *Leptothorax* in the Eastern and Central States as far west as Missouri, but *rugatulus* and its varieties are confined to the Western States. The two forms also differ in habits, *rugatulus* and its varieties nesting under stones and *curvispinosus* in hollow twigs and old galls.

40. *Leptothorax rugatulus* var. *cockerelli* Wheeler.

New Mexico: Las Vegas Hot Springs, type locality (T. D. A. Cockerell).

Arizona: Miller, Carr and Ramsay Canyons, Huachuca Mts. (Biedermann, Mann and Wheeler).

41. *Leptothorax rugatulus* var. *mediorufus* var. nov.

Worker. Length 2.5–3 mm.

A little larger, much more coarsely sculptured and of a much deeper color than the var. *cockerelli* and the subsp. *annectens*. Upper surface of head and gaster black; mandibles, clypeus, antennæ, thorax, petiole, postpetiole and a spot at the base of the first gastric segment ferruginous red; margins of gastric segments yellowish; legs yellowish brown, the femora infuscated in the middle. Rugosity of head, thorax and petiole coarse; head but slightly shining; thorax, petiole and postpetiole opaque, densely punctate. Declivity of epinotum transversely rugulose. Epinotal spines a little stouter but not more curved than in the typical *rugatulus*.

Female. Length 3.5 mm.

Decidedly larger than the female of *cockerelli*, with the body very dark brown, the antennæ, mandibles, legs and incisures of the gaster light brown. Surface of head, thorax and pedicel quite as coarsely sculptured as in the worker and much less shining than in *cockerelli* and the typical *rugatulus*. Wings whitish hyaline, with nearly colorless veins and pale brown stigma.

Described from many workers and three females from several colonies found near Lake Tahoe, Cala. (Tallac, Glen Alpine) and about Camp Curry in the Yosemite Valley. A series of workers and two winged females taken by Prof. J. C. Bradley at Volcano Creek in Southern California also belong to this form.

42. *Leptothorax rugatulus* Emery subsp. *annectens* Wheeler.

The four cotype workers taken at Boulder by Rev. P. J. Schmitt remain the only specimens I have seen of this form.

43. *Leptothorax rugatulus* subsp. *brunnescens* subsp. nov.

Worker. Length 1.6–2 mm.

Decidedly smaller than the preceding forms of the species and much more feebly sculptured, so that the surface of the head, thorax and pedicel is distinctly shining. The epinotal spines are shorter than their distance apart at the base, very feebly curved and slightly deflected at their tips. The postpetiole is nearly twice as broad as long, with prominent, but rounded anterior corners. The petiolar node seen from above is as broad as long, and as in the other forms broader behind than in front. In the other forms the segment is considerably longer. The color is dull yellowish brown, with the upper surface of the head and gaster, the summits of the petiolar and postpetiolar nodes and the middle portions of the femora darker brown.

Described from twenty workers taken by Dr. S. J. Hunter in Creede County, Colorado, at an altitude of 8844 ft.

44. *Leptothorax (Mychothorax) muscorum* Nyl. var. *sordidus* Wheeler.

Colorado: Boulder (P. J. Schmitt).

45. *Leptothorax (Mychothorax) muscorum* var. *septentrionalis* var. nov.

Worker. Length 2.5 mm.

Resembling the var. *sordidus,* but with the head and gaster dark brown or black above, the paler portions of the body of a deeper and more ferruginous red and the rugosity and punctuation decidedly coarser, so that the head, thorax, petiole and postpetiole are nearly opaque. The petiolar node is blunter and more rounded above in profile than in *sordidus* and the typical *muscorum* of Europe.

Female. Length 2.9 mm.

Dark brown; head black; venter yellowish, much of the pleurae lower surfaces of petiole and postpetiole, mandibles, legs and antennae, except the clubs, paler brown. Thorax subopaque, densely punctate, pronotum transversely, mesonotum longitudinally rugulose. Wings white, with colorless veins and brown stigma. Pilosity much as in the worker.

Male. Length 2.6–3 mm.

Black, legs and incisures of gaster dark brown. Wings as in the female. Head, thorax, petiole and postpetiole subopaque, densely rugulose-punctate. Pilosity abundant, short and white.

Described from numerous specimens of all three phases, which I took from several colonies nesting under stones on the southern slope of Tunnel Mt. at Banff, Alberta, a series of workers collected by Dr. C. Gordon Hewitt at Sulphur Springs, near Banff and a few workers which I found in the Yoho Pass, near Emerald Lake, British Columbia. At first sight this ant closely resembles *L. rugatulus* var. *mediorufus* but it can be readily distinguished by the feeble transverse mesoëpinotal impression and faintly indicated promesonotal suture.

46. *Leptothorax (Mychothorax) acervorum* Mayr subsp. *canadensis* Provancher.

Washington: Olympia (T. Kincaid).

Colorado: Florissant (Wheeler); Ward and Pikes Peak, 10,000 ft. (T. D. A. Cockerell).

Utah: Little Willow Creek, Salt Lake Co. (R. V. Chamberlin).

Maine: Orono (H. H. Severin).

New Hampshire: Franconia and summit of Mt. Washington (Mrs. A. T. Slosson).

This species was originally described from Canada. The following smaller and darker variety is also widely distributed through the Canadian Zone but seems to be rare and local:

47. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *convivialis* Wheeler.

Wisconsin: Milwaukee, type locality (Wheeler).

New Mexico: Beulah, 8000 ft. (F. W. P. Cockerell); Top of Las Vegas Range, 11,000 ft. (T. D. A. Cockerell).

Connecticut: Colebrook (Wheeler).

Nova Scotia: Digby (J. Russell).

Newfoundland: Spruce Brook.

This form was described as *L. canadensis* subsp. *obscurus* by Viereck in a paper on the Hymenoptera of Beulah New Mexico (Trans. Amer. Ent. Soc. 29, 1903) which appeared a month later than my revision of the species of *Leptothorax.*

48. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *kincaidi* Pergande.

Four workers and a deälated female taken by Mr. F. H. Whitney on the Upper Kugarok River, north of Nome, Alaska (65°!) are clearly referable to this variety, originally described from Metlakahtla. Both phases are larger (worker 3 mm.; female 4 mm.) and more coarsely sculptured than our other North American forms. In my workers the reddish brown thorax has a black crescent on the pronotum and the upper surface of the epinotum and the petiole and postpetiole are of the same color. The epinotal spines are long, thick and blunt, the antennal scapes reach only a little more than half the distance between the eyes and posterior corners of the head. The hairs on the legs are short, coarse and suberect.

49. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *yankee* Emery.

British Columbia: Glacier (Wheeler); Rogers Pass and Prairie Hills, Selkirk Mts. and Carbonate (J. C. Bradley).

Alberta: Lake Louise and Moraine Lake, Valley of the Ten Peaks (Wheeler).

Colorado: Boulder (P. J. Schmitt and W. W. Robbins).
South Dakota and Utah: (Emery).
Michigan: Washington Harbor, Isle Royale (O. McCreary).

At Glacier and Lake Louise I found several colonies of this ant nesting under stones in rather damp places. The worker form, originally described from South Dakota, Utah and Colorado, differs from the typical *canadensis* and the preceding varieties in its somewhat finer sculpture and paler color, the mandibles, antennae, except their clubs, the thorax, pedicel and legs being reddish brown or red, the femora infuscated in the middle. The epinotal spines are rather long and pointed. The male measures 4 mm. and is distinctly larger than the worker (2.5–3 mm.) and only slightly smaller than the typical *acervorum*, from which it is almost indistinguishable. Comparison with Swiss specimens shows that the American variety has a darker pterostigma and smaller epinotal protuberances. The female is somewhat smaller and darker than the female of the typical *acervorum*.

50. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *canadensis* var. *calderoni* Forel.

I have taken numerous workers and females of this form in the type locality (about Lake Tahoe, Cala.), where it is common in little nests in the bark of large pine logs and stumps, often in plesiobiosis with *Camponotus herculeanus* var. *modoc*. The worker has the color of the var. *yankee*. According to Forel the antennal scapes are longer than in *canadensis*, reaching nearly to the posterior corners of the head, but my specimens show considerable variation in this particular. Nor do I find that the worker *calderoni* is larger than the European *acervorum*, though it is larger than the var. *yankee*. My workers vary considerably in size, from 2.5–3.5 mm. The main difference which I detect between *yankee* and *calderoni* is in the proportions of the promesonotum, the length of this region in the latter form between the cervical ridge of the pronotum and the mesoëpinotal suture being more than $1\frac{1}{2}$ times the breadth of the pronotum through the humeri, whereas in *yankee* it is distinctly less. Sculpture and pilosity are very similar in the two forms.

51. *Leptothorax* (*Mychothorax*) *acervorum* subsp. *crassipilis* subsp. nov.

Worker. Length: 2.5–3 mm.

Differing conspicuously from the preceding forms of *acervorum* in sculpture and pilosity. The surface of the head, thorax, petiole and

postpetiole is distinctly though feebly shining owing to the more superficial punctuation. The rugae on the head and thorax are much more distinct, coarser and further apart. The blunt, erect hairs on the upper surface of the body, especially on the head, thorax and pedicel are much longer, coarser and glistening white. The hairs on the legs seem also to be somewhat coarser than in the various forms of *canadensis*. The spines of the epinotum are scarcely more than half as long as their distance apart at the base, acute and rather slender. The antennal scapes reach about half way between the eyes and the posterior corners of the head and the basal funicular joints are distinctly shorter and more transverse than in *canadensis* and its varieties. Color dark brown or castaneous, head and sometimes the gaster darker and more blackish; mandibles, antennae and legs pale brown; middle portions of femora, but not the antennal clubs, infuscated.

Female. Length: 3.5 mm.

Very similar to the worker, the rugosity of the head and thoracic dorsum and the pilosity of the head and thorax even a little coarser and more conspicuous. Body uniformly castaneous, except the pale incisures of the gaster. Wings grayish hyaline, veins pale brown, pterostigma dark brown.

Male. Length 3–3.5 mm.

Much smaller than the male of *canadensis* and *acervorum*. Dark brown; head black, mandibles and legs pale brown, tarsi paler. Wings white, with pale brown veins and stigma. Sculpture of head and thoracic dorsum distinctly more superficial than in *canadensis* var. *yankee* and *calderoni*, the head, especially, more shining. Pilosity not more abundant, but paler.

Described from numerous specimens of all three phases taken from small colonies under stones in several localities (Manitou, Cheyenne Creek, Red Rock Canyon, Williams Canyon) near Colorado Springs during July and August, 1903. This form is so distinct that it might be regarded as an independent species, but as it has the shape of *acervorum* and the median impression of the clypeus I prefer for the present to regard it as a subspecies.

52. *Leptothorax* (*Mychothorax*) *emersoni* Wheeler subsp. *glacialis* Wheeler.

Colorado: Florissant 8500 ft. (Wheeler).

As I have shown (Bull. Wis. Nat. Hist. Soc. 5, 1907, p. 78 *et seq.*), this subspecies lives in the colonies of *Myrmica brevinodis* var. *subalpina* in much the same manner as the typical *emersoni* of New England and Canada lives with *M. brevinodis* var. *canadensis*.

53. *Leptothorax* (*Mychothorax*) *emersoni* subsp. *hirtipilis* subsp. nov.

Worker. Length 2.5 mm.

Differing from the typical *emersoni* and the preceding subspecies in the following characters: the mesoëpinotal constriction is more pronounced, the pro- and mesonotum being somewhat more convex and at a higher level than the base of the epinotum. The sculpture is much coarser, the rugae on the head being very sharply defined even on the occiput and posterior corners; on the thoracic dorsum the rugae are vaguely longitudinal. The head, thorax and petiole are decidedly opaque. The pilosity is much coarser and more abundant, especially on the thorax and legs. The color is a little darker than that of *emersoni* and *glacialis*, with only the anterior border of the gaster yellowish.

A single specimen taken from a nest of *Myrmica brevinodis* var. *subalpina* on the southern slope of Tunnel Mt., at Banff, Alberta. This shows that the habits are symbiotic as in the other forms of the species.

54. *Leptothorax* (*Mychothorax*) *hirticornis* Emery subsp. *formidolosus* Wheeler.

Colorado: Flagstaff Mt., Boulder Co. (T. D. A. Cockerell).

South Dakota: Hill City (Pergande Coll. Nat. Mus.).

55. *Aphaenogaster subterranea* Latr. subsp. *occidentalis* Emery.

Washington: Pullman, type locality (Pergande); Pullman and Wawawai (W. M. Mann); Almota (A. L. Melander); Olympia (T. Kincaid).

Oregon: Ashland (W. Taverner).

California: Pacific Grove, Mt. Tamalpais, Yosemite and Lake Tahoe (Wheeler); Palo Alto and King's River Canyon (H. Heath); Corte Madera Creek, Santa Cruz Mts. (W. M. Mann); Mountain View.

Idaho: Moscow (J. M. Aldrich).

Utah: East Mill Creek, Salt Lake Co. (R. V. Chamberlin).

Colorado: Cheyenne Canyon near Colorado Springs and Boulder (Wheeler).

Montana: Helena (W. M. Mann).

British Columbia: Dog Lake, Penticton (C. G. Hewitt).

This subspecies is extremely common in both the Coast Range and the Sierras of California from sea-level to an elevation of 6000 ft. It appears to be equally common in Oregon and Washington but is much more sporadic in the other localities cited.

56. *Aphaenogaster subterranea* subsp. *valida* Wheeler.

Recently described from Cheyenne Canyon, near Colorado Springs.

57. *Aphaenogaster subterranea* subsp. *valida* var. *manni* var. nov.

Worker. Length 4–5 mm.

Differing from the typical *valida* in color, the body and antennae being yellowish brown throughout, the mandibles, clypeus, and legs paler and clearer yellow. The sculpture of the epinotum and mesopleuræ and sides of the pronotum much feebler and the upper surface of the pronotum more shining.

Numerous workers from Pullman, Washington, (W. M. Mann). Other workers from the same locality but from different nests have the head and gaster darker than the thorax and thus represent transitions to the typical *valida*.

58. *Aphaenogaster subterranea* subsp. *borealis* Wheeler.

Recently described from worker specimens taken by Prof. J. C. Bradley at Lardo, Kootenay Lake, British Columbia. A number of workers taken by Dr. C. G. Hewitt at Arrowhead Lake, British Columbia, though slightly darker, are also referable to this subspecies.

59. *Aphaenogaster patruelis* Forel.

Known only from the Island of Guadeloupe off the coast of Lower California.

60. *Aphaenogaster patruelis* var. *bakeri* Wheeler.

This variety was taken several years ago on Catalina Island off the coast of Southern California by Prof. C. F. Baker.

61. *Aphaenogaster patruelis* var. *carbonaria* Pergande.

According to Forel, this form, originally described as a species, is merely a somewhat darker and more coarsely sculptured variety of *patruelis*. The types were taken by Eisen at Sierra Laguna and El Chinche in Lower California.

62. *Aphaenogaster mutica* Pergande.

Known from Lower California, Northern Mexico and Western Texas.

63. *Aphaenogaster texana* Emery.

Recorded from Texas, Arizona and Kansas.

64. *Aphaenogaster texana* var. *furvescens* Wheeler.
Described from the Huachuca Mts., Arizona.

65. *Aphaenogaster fulva* Roger subsp. *aquia* Buckley var. *rudis* Emery.

Several workers, a deälated female and a male of this form were taken by me at Boulder, Colo. July 29, 1906. Like other forms of the species it is common in the Central and Eastern States and reaches the western limit of its range on the eastern slopes of the Rocky Mts.

66. *Aphaenogaster fulva* subsp. *aquia* var. *azteca* Emery.

A form closely related to the preceding but more coarsely sculptured. It was described from Mexico without more precise locality.

67. *Aphaenogaster uinta* sp. nov.

Worker. Length 4.5–5 mm.

Head subrectangular, a little longer than broad, as broad in front as behind, with straight sides and rounded posterior corners and with a distinct pit-like impression in the median line on the vertex between the eyes. These are rather large, convex and situated near the median transverse diameter of the head. Mandibles with straight external borders and convex tips, with three larger apical and several more indistinct basal teeth. Clypeus moderately convex, its anterior border rather deeply notched in the middle. Frontal area distinct; frontal carinae small, erect in front, continued behind into slightly converging ridges. Antennae slender; scapes surpassing the posterior border of the head by somewhat less than $\frac{1}{6}$ their length, curved at the base and slightly thickened at the apex; funiculi with a distinct 4-jointed club; first funicular joint longer than second; joints 2–7 subequal, nearly twice as long as broad, joints 8–10 subequal, less than twice as long as broad, terminal joint distinctly longer. Thorax slender; pro- and mesonotum together forming a convex, hemispherical mass, the anterior border of the mesonotum not projecting above the pronotum, sloping and concave behind. Seen from above the mesonotum is narrow, more than twice as long as broad. Mesoëpinotal constriction rather deep. Epinotum long, somewhat less than twice as long as high, in profile with the base perfectly straight and horizontal, and on each side passing into the declivity, with a rectangular projection, representing the spine of other species. Seen from above the dorsal surface of the base is longitudinally impressed in the middle. Petiole short, its peduncle shorter than the node, which is

nearly as high as the length of the segment, conical in profile, with strongly concave anterior and abrupt and feebly convex posterior slope. Seen from above the petiole through the node is about one half as broad as its length. Postpetiole shaped like the petiolar node in profile but somewhat lower, from above a little longer than broad and a little broader than the petiole. Gaster rather large, broadly elliptical. Legs moderately slender; spurs distinct on the median and hind tibiae.

Shining; mandibles densely striated, clypeus and antennal scapes finely longitudinally rugulose. Anterior portion of head to a short distance behind the eyes finely punctate and feebly longitudinally rugose. Posterior portion of head more shining, more sparsely and more superficially punctate. Pro- and mesonotum above smooth and shining, feebly shagreened; pleurae and epinotum punctate-rugulose and subopaque, the rugules on the base of the epinotum very fine, transverse. Petiole and postpetiole finely shagreened, feebly shining. Gaster very smooth and shining, superficially but distinctly shagreened, with sparse piligerous punctures. Legs moderately shining, finely shagreened.

Hairs yellowish; coarse, sparse and erect on the body, very short and subappressed on the antennal scapes and legs.

Yellowish red; legs more yellowish; gaster black or very dark brown, posterior borders of segments and anal region testaceous.

Female. Length about 7 mm.

Head scarcely longer than broad, distinctly broader behind than in front, with more rounded posterior corners than in the worker. Thorax through the wing-insertions as broad as the head through the eyes. Epinotum with two strong, acute spines, which are as long as broad at their bases. In profile the declivity is concave and distinctly shorter than the nearly straight, sloping base. Both the petiole and postpetiole, with their nodes, more compressed anteroposteriorly than in the worker. Wings rather long (8 mm.).

In sculpture, pilosity and color resembling the worker, but the head more opaque and more rugose behind. Pronotum transversely rugulose, mesonotum and scutellum and portions of mesopleurae smooth and shining; epinotum subopaque, its base transversely, its sides longitudinally rugulose. Mesonotum with three elongate brown blotches. Wings grayish hyaline, with pale brown veins and conspicuous dark brown stigma.

Male. Length nearly 4 mm.

Head a little longer than broad, flattened, rounded behind, with

straight, marginate occipital border, large eyes and ocelli and very short cheeks. Mandibles small, with 5 or 6 teeth. Clypeus convex, its border straight and entire in the middle. Antennae slender, scapes as long as the first and second funicular joints together; joints of club strongly constricted at their proximal ends so that this portion of the antennae is moniliform. Mesonotum convex, distinctly longer than broad; scutellum as long as broad; base of epinotum straight in profile, gradually sloping to the posterior swellings which are feebly developed, rounded above and angulate behind, but not pointed. Nodes of petiole and postpetiole low and rounded. Legs slender.

Mandibles subopaque, very finely and indistinctly striate; clypeus smooth and shining; head subopaque, obscurely punctate-rugulose. Remainder of body smooth and shining, except the posterior swellings of the epinotum, which are subopaque and irregularly rugose.

Pilosity much as in the worker, but the long, erect hairs on the gaster finer.

Piceous; clypeus and legs pale brown; head black; mandibles and antennae sordid yellow. Wings as in the female, but a little more whitish.

Described from seventeen workers, one female and one male taken by Dr. R. V. Chamberlin at East Mill Creek, Salt Lake County, Utah.

This form is evidently quite distinct from any of our other North American species of *Aphaenogaster* though most closely related to *subterranea*. The worker and female of *uinta* can be distinguished from the various forms of this species by their color, the greater length of the scapes and funicular joints and the much larger eyes, the worker by its more rectangular head, peculiar epinotum, more conical postpetiole and larger gaster, the female by its smaller head, shorter epinotal spines and much darker pterostigma, the male by the very different epinotum, longer mesonotum, more shining and much less densely sculptured head and the paler body and appendages.

68. *Stenamma nearcticum* Mayr.

This species is known only from male and female specimens. What Mayr took to be the worker belongs to *brevicorne*. The types were from California. My collection contains a male and female from Corvallis, Oregon.

69. *Stenamma brevicorne* Mayr subsp. *diecki* Emery.

British Columbia: Yale, type locality (G. Dieck).

Illinois: Rockford (Wheeler).

Pennsylvania: Beatty (P. J. Schmitt).
Connecticut: Colebrook (Wheeler).

70. *Stenamma brevicorne* subsp. *heathi* Wheeler.
California: King's River Canyon (H. Heath).
Easily recognized by its uniform light red color and coarse sculpture.

71. *Stenamma brevicorne* subsp. *sequoiarum* subsp. nov.
Worker. Length 3–3.3 mm.

Resembling the subsp. *heathi* but larger and of the same color as *diecki,* with even coarser sculpture than the former, the rugae on the head being stronger and those on the pronotum very coarse and sparse, more longitudinal and less reticulate. The postpetiole is evenly and sharply longitudinally rugose and the rugae at the extreme base of the gaster are very distinct. The base of the epinotum is coarsely and vermiculately rugose. Head broader and the postpetiole distinctly longer than broad, its node lower and less convex than in *diecki* and *heathi.* The basal funicular joints are broader and slightly longer than in the other subspecies of *brevicorne.* Hairs on the body less abundant and more appressed, especially on the gaster and tibiae. Surface of the head, thorax and pedicel distinctly shining as in *heathi* and somewhat more opaque than in *diecki.*

Female (deälated). Length 3.6 mm.

Resembling the worker; larger than the female *diecki,* with more robust thorax and the whole body paler and more reddish. The sculpture is coarser, the upper surface of the mesonotum and scutellum more sharply longitudinally rugose. Funicular joints longer, hairs on the legs more appressed.

Described from a single female and numerous workers taken from several colonies nesting under stones among the large red-wood trees in Muir Woods on Mt. Tamalpais, Cala. A series of workers taken by Prof. H. Heath several years ago at Pacific Grove, Cala. appear to connect this subspecies with *diecki.* They are somewhat smaller than the specimens of *sequoiarum* and have a more convex postpetiole, which is longitudinally striate only on the sides and smooth and shining above. The head is somewhat more elongate and the basal funicular joints narrower and shorter. Both these specimens and those of *sequoiarum* may represent the unknown workers of *S. nearcticum.*

72. *Stenamma manni* Wheeler.
Known only from worker and female specimens taken by Dr. W. M. Mann at Chico in Hidalgo, Mexico.

Dolichoderinae.

73. *Liometopum apiculatum* Mayr.

Mexico: Volcan de Colima, 7500 ft. (C. H. T. Townsend); Pinos Altos, Chihuahua and Ciudad de Durango, 8100 ft. (cited in Biol. Centr. Amer.); Guerrero Mill, Hidalgo, 9000 ft. (W. M. Mann).

Arizona: Huachuca Mts. 5000 ft. (Biedermann).

New Mexico: Las Vegas (Wheeler); Las Vegas Hot Springs, 6226 ft. and Romeroville (T. D. A. Cockerell); High Rolls, 6550 ft., Alamogordo, 4320 ft. (G. V. Krockow) and Beulah, 8000 ft. (H. Viereck).

Texas: Paisano Pass, 5079 ft. and Fort Davis, 5400 ft. (Wheeler).

Colorado: Canyon City, 5329 ft. and Cotopaxi 6371 ft. (P. J. Schmitt); Manitou and Cheyenne Canyon, 7000 ft. (Wheeler).

This ant seems always to be associated with live-oaks. Its habits, so far as I have been able to observe them, have been described in my paper "The North American Ants of the Genus Liometopum" (Bull. Amer. Mus. Nat. Hist. 21, 1905, pp. 321–333).

74. *Liometopum apiculatum* subsp. *luctuosum* Wheeler.

Colorado: Cheyenne Canyon, 7000 ft. near Colorado Springs, type locality (Wheeler).

Arizona: Grand Canyon 4000–7050 ft. and Prescott, 5320 ft. (Wheeler).

California: Baldy Peak, San Gabriel Mts., 6500 ft. (Brewster, Joos, and Crawford); Tenaya Canyon, Yosemite, 5000 ft. (Wheeler).

Though rarer and more sporadic than the typical form of the species and *occidentale*, this subspecies seems to have a wide range. The few colonies seen in the Yosemite were running on pine trees. This seems to confirm the opinion I advanced in 1905 that *luctuosum* is definitely associated with conifers.

75. *Liometopum occidentale* Emery.

California: San Jacinto, 1533 ft. (type locality); Mariposa 1962 ft.; Pasadena and Yosemite 4000 ft. and Wawona (Wheeler); Baldy Peak, San Gabriel Mts. (Brewster, Joos and Crawford); Claremont (C. F. Baker and Wheeler); Coalinga, below 500 ft., Fresno County, Ontario and Alpine (J. C. Bradley).

Oregon: Corvallis.

I have recently found a few specimens of the hitherto unknown female and male of this ant from San Jacinto, Cala., in the Pergande

Collection (U. S. Nat. Mus.). They differ so much from the corresponding phases of *apiculatum* that *occidentale* can no longer be regarded as a mere variety of the former, but must be elevated to specific rank. Comparison of the female and male of *occidentale*, however, with those of the European *L. microcephalum* may show closer affinities with this species, as a variety of which Emery originally described *occidentale*. The following descriptions are drawn from two females and a male:

Female. Length 10–10.5 mm.; wings 11.5 mm.

Much smaller than *apiculatum* and with much shorter wings (length of *apiculatum* 12–14 mm.; wings 17–18 mm.) and differing also in the following characters: The head, excluding the mandibles, as long as broad; with the scapes not reaching to the posterior corners, the frontal groove very sharp and distinct and extending from the frontal area to the anterior ocellus. Thorax through the wing insertions not broader than the head, the flattened mesonotum distinctly longer than broad. Surface of the body shining, though coarsely shagreened and sparsely punctate. Hairs short and rather numerous, but much shorter and less abundant than in *apiculatum*. Color ferruginous brown, gaster darker, lower surface of head, thoracic sutures and legs paler and more yellowish. Wings whitish hyaline, not infuscated as in *apiculatum*, with paler veins and brown stigma and subcostal vein.

Male. Length 9 mm.; wings 10 mm.

Differing from the male *apiculatum* in its smaller size, shorter wings and antennae (length of *apiculatum* 9–11 mm.; wings 14 mm.), with the wings pale like those of the female, the gaster, legs, genitalia and antennae reddish brown and the hairs, especially on the head, thorax and legs conspicuously shorter and less abundant. The volsellae of the genitalia are shorter and their tips slightly crenate along the dorsal border, whereas this border is smooth in *apiculatum*.

L. occidentale is very abundant among live oaks at low altitudes in the Coast Range of California but less common in the Sierras. It seems not to occur on their eastern slopes, judging from my inability to find it in the Lake Tahoe Region. Only a few colonies were seen in the Yosemite; at Wawona it was more abundant.

76. *Tapinoma sessile* Say.

Washington: Almota (A. L. Melander); Orcus Island, San Juan Island, Pullman and Ellensburg (W. M. Mann); Rock Lake.

California: San Jose and Palo Alto (H. Heath); Lompoc, Mt. San Jacinto, Harris, Humboldt County and summit of Mt. Wilson (J. C.

Bradley); Whittier and Azusa (W. Quayle); Yosemite and Lake Tahoe (Wheeler).

Washington: "Throughout the state" (W. M. Mann).

Idaho: Market Lake (J. M. Aldrich).

Nevada: King's Canyon, Ormsby Co. (C. F. Baker).

Colorado: Ward 9000 ft. (T. D. A. Cockerell); Buena Vista, Salida, Colorado Springs, Florissant and Boulder (Wheeler); Eldora, 8600 ft. and Swift Creek, (W. P. Cockerell); Creede Co. 8844 ft. (S. J. Hunter); Tolland and Boulder, 5000–10500 ft. (W. W. Robbins).

New Mexico: Las Vegas (Wheeler); Harvey's Ranch, Las Vegas Range, 10,000 ft. (Ruth Raynolds); Manzanares (Mary Cooper); Pecos and Albuquerque (T. D. A. Cockerell).

Arizona: Grand Canyon (Wheeler); Huachuca Mts., 5000 ft. (Biedermann and Wheeler).

Texas: Jefferson (E. S. Tucker).

Montana: Flathead Lake (C. C. Adams).

British Columbia: Golden (W. Wenman); Emerald Lake (Wheeler).

Alberta: Banff (Wheeler).

This ant is equally abundant and widely distributed in the whole region between the area covered by this list of localities and the Atlantic sea-board. It is an essentially eurythermal species, always nesting under stones, logs or bits of wood in open places. The large number of specimens which I have accumulated show considerable variations in size and coloration and some minor structural differences, so that one or more subspecies or varieties may have to be recognized when the material is more closely studied.

Camponotinae.

77. *Prenolepis imparis* Say.

California: Piedmont, Alameda County and Berkeley (J. C. Bradley); Point Loma, near San Diego (P. Leonard); Palo Alto and San Jose (H. Heath); Santa Inez Mts. near Santa Barbara, Pasadena, San Diego, Claremont, San Gabriel Mts. and Yosemite Village (Wheeler).

Nevada: Ormsby County (C. F. Baker).

Oregon: Ashland (W. Taverner).

Arizona: Grand Canyon, 3670 ft. (Wheeler); Ramsay Canyon, Huachuca Mts. (W. M. Mann).

Colorado: Cheyenne Mt. near Colorado Springs (Wheeler).

Mexico: Colima, 7500 ft. (C. H. T. Townsend).

This species is also very common throughout North America east of the Mississippi River from Southern Ontario to St. Augustine, Florida, where it was taken by Prof. C. T. Brues. It belongs properly to the transition zone and is, according to my observations, always associated with oak trees. In the Eastern States the var. *testacea* Emery descends into the Upper and Lower Austral. It is one of the most abundant ants in the sandy pine-barrens of New Jersey and at low altitudes in the mountains of North Carolina. As Emery has shown, the European *nitens* Mayr is merely a subspecies of *imparis* with darker wings in the male and female (Deutsch. Ent. Zeitschr. 1910). This author has called attention to the remarkable distribution of the species, the subsp. *nitens*, the only known Old World form, being confined to Carinthia, Styria, the Balkan Peninsula, Asia Minor and the eastern shores of the Black Sea, whereas the typical form of the species has a very wide range in North America.

78. *Lasius niger* L. var. *sitkaënsis* Pergande.

Alaska: Sitka, type locality (T. Kincaid).

British Columbia: Glacier (Wheeler); Dowie Creek and Rogers Pass, Selkirk Mts. (J. C. Bradley).

Manitoba: Aweme (N. Criddle); Treesbank (C. G. Hewitt).

Ontario: Kenora (J. C. Bradley).

Washington: Olympia (T. Kincaid); Seattle (Wheeler); Pullman (W. M. Mann).

Oregon: Corvallis.

Idaho: Troy (W. M. Mann); Moscow (J. M. Aldrich).

Montana: Yellow Bay, Flathead Lake (C. C. Adams).

South Dakota: Elk Point (E. N. Ainslie).

California: Giant Forest, 6500 ft. (J. C. Bradley); Lake Tahoe, 6000–7000 ft. and Camp Curry and Glacier Point, 4000–8000 ft. Yosemite (Wheeler); King's River Canyon (H. Heath).

Colorado: Florissant, 8200 ft., Cheyenne Canyon and Williams Canyon, 8000 ft. (Wheeler); Denver (E. S. Tucker); Platte Canyon, 10,000 ft. and Rico, 10,000 ft. (E. J. Oslar).

Nova Scotia: Port Maitland (W. Reiff).

Maine: South Harpswell (Wheeler); Reed's Island, Penobscot Bay (A. C. Burrill).

As shown by the list of localities, this form is very widely distributed through the Canadian zone. The worker and female are larger than any of our other North American forms of *L. niger* (3.5–4 mm. and

8–9 mm. respectively) and quite as large as those of the typical Eurasian form of the species. The worker has the same abundant pubescence and erect hairs on the legs and scapes, but in the female the hairs are less abundant. The ocelli of the worker are very distinct. The body is yellowish brown, with the upper surface of the head, thorax and gaster darker and the appendages a little paler. The wings of the female measure 10–10.5 mm. and are uniformly pale yellowish brown, whereas those of the typical *niger* are colorless. The male *sitkaënsis* is scarcely smaller than the male *niger* dark brown and with the wings faintly tinged with the same color. This form passes by gradations into the smaller and darker variety, *neoniger* Emery and also approaches the true *niger* and the subspecies *alienus*. Thus the workers of some of the colonies found at Lake Tahoe and in the Yosemite are much like the European *niger*, whereas others are smaller and, except for their pilosity, might be confounded with large forms of *alienus* or its variety *americanus* Emery.

79. *Lasius niger* var. *neoniger* Emery.

Alberta: Banff (Wheeler).

California: Lake Tahoe (Wheeler).

South Dakota: Elk Point (C. N. Ainslie).

Colorado: Broadmoor, near Colorado Springs, Florissant and Salida (Wheeler); Ward, 9000 ft. and Steamboat Springs (T. D. A. Cockerell).

New Mexico: Viveash Ranch, 9000 ft. (Cockerell).

Washington: Pullman (W. M. Mann and R. W. Doane); Union City (J. C. Bradley).

This variety is also common in cool woods or at higher altitudes throughout the maritime provinces of Canada and the Eastern and Central States as far south as the Black Mts. of North Carolina. The worker and male measures only 2–2.5 mm., the female 6–7 mm. The wings of the female measure 8–9 mm. and both in this sex and the male are clear and hyaline. The body of the worker and female is dark brown or black and the erect hairs on the dorsal surface and on the legs and scapes are abundant and conspicuous.

80. *Lasius niger* subsp. *alienus* Forster var. *americanus* Emery.

Alberta: Banff (J. C. Bradley).

British Columbia: Glacier, Field and Emerald Lake (Wheeler); Carbonate (J. C. Bradley).

Colorado: Denver (E. Bethel); Silverton, 10,000 ft. (E. J. Oslar);

Manitou and Salida (Wheeler); Boulder (T. D. A. Cockerell); Canyon City (P. J. Schmitt).

Idaho: Julietta (J. M. Aldrich); Troy (W. M. Mann).

Utah: East Mill Creek, Salt Lake Co. (R. V. Chamberlin).

New Mexico: Gallinas Canyon (T. D. A. Cockerell); Las Valles (Mary Cooper).

Arizona: Grand Canyon, 7000 ft. (Wheeler).

California: Glacier Point, 8000 ft., Yosemite (Wheeler).

Very common throughout the Middle and Eastern States as far south as Georgia. That this variety should be attached to the European subsp. *alienus* and not to the typical *niger* is evident from the absence of erect hairs on the legs and antennal scapes and the sparse pilosity of the body, and also from the fact that the female, especially in the mountains of the western states, is indistinguishable in stature from the female of the true *alienus*, measuring nearly 8 mm., with wings 9–10 mm. long, although the females of the typical eastern *americanus* are often not more than 5–5.5 mm., with wings not exceeding 8 mm. Both forms may occur in some of the middle-western states, e. g. in Illinois and Wisconsin. The western form might be distinguished as a variety, for which the name *alieno-americanus* would be appropriate. The males, too, vary greatly in size and the differences of color among the workers of different colonies are considerable. In the Eastern States the workers of a form always found in dry sandy fields are very pale, almost drab-colored, whereas in adjacent woodlands the workers are always darker, varying from dark brown to black. Future study on the basis of a large amount of material will probably lead to the distinction of a number of forms of *L. niger* in North America, where the species is more variable than it is in Europe.

81. *Lasius* (*Formicina*) *brevicornis* Emery.

Montana: Elkhorn (W. M. Mann).

Colorado: Cheyenne, Canyon, near Colorado Springs (Wheeler).

New Mexico: San Geronimo (Mary Cooper).

This species, which is very common under stones on dry sunny hill slopes in New England and New York, is rare in the Western States.

The worker specimens from Colorado and New Mexico approach those of the following subspecies in the shape of the petiolar node and in having slightly smaller eyes than the typical form, but the differences are not sufficient to justify a new varietal name.

82. *Lasius* (*Formicina*) *brevicornis* subsp. *microps* subsp. nov.

Worker. Differing from the typical *brevicornis* in the much smaller

and more nearly circular eyes which have only 11–13 ommatidia. The funicular joints of the antennae are slightly longer. The petiole is narrower, with straight sides and broadly and feebly emarginate superior border, whereas the typical *brevicornis* has the node entire with more rounded sides and border. The pubescence on the head and thorax is distinctly shorter so that the surface is more shining and the color of the body is not a pure but a more brownish yellow.

Described from numerous specimens taken from a large colony under a stone at Yosemite Village, 4000 ft., Cala.

83. *Lasius* (*Formicina*) *flavus* Fabr. subsp. *nearcticus* Wheeler.

Colorado: Topaz Butte, 9000 ft., near Florissant, and Salida (Wheeler).

This form is common throughout the Eastern and Middle States but evidently rare in the arid west, probably because of its preference for damp, shady situations. In the eastern states and Canada I have found it only in moist woods.

84. *Lasius* (*Formicina*) *flavus* subsp. *claripennis* subsp. nov.

Worker. Length 2.6–3 mm.

Similar to the typical *flavus* of Europe and the subsp. *nearcticus* but averaging smaller and with the antennae shorter, the scapes scarcely surpassing the posterior corners of the head. The color of the body is brownish yellow as in the true *flavus* and not pale yellow with whitish gaster as in *nearcticus*. The eyes are distinctly smaller and much as in the European subsp. *myops* Forel.

Female. Length 7 mm.

Differing from the female *flavus* and *nearcticus* in the shorter antennae, the scapes of which reach only to the posterior corners of the head. The wings are not infuscated at the base as in these forms, but clear and hyaline throughout and the posterior portion of the head and thoracic dorsum is dark brown, much darker than in *nearcticus* and perceptibly darker than in the typical *flavus*.

Male. Length 3 mm.

Differing from the male *flavus* and *nearcticus* in having slightly shorter antennae, in its smaller size and the darker, nearly black color of the body.

Described from numerous workers, four females and six males taken Aug. 20th from several colonies nesting under stones on the southern slope of Tunnel Mt. at Banff, Alberta. Several workers received from Farewell Creek, Southern Saskatchewan (E. G. Titus), three workers from Pullman, Washington, and a series of workers, males

and females from Creede Co., Colo., 8844 ft. (S. J. Hunter) also belong to this subspecies. It is evidently quite distinct from the other forms of *flavus*. It resembles the subspecies *myops* in preferring hot, stone-covered slopes to moist, shady places as a habitat.

85. *Lasius* (*Formicina*) *umbratus* Nyl. subsp. *subumbratus* Viereck.

New Mexico: Beulah, 8000 ft., type-locality (T. D. A. Cockerell).

Colorado: Cheyenne Canyon near Colorado Springs, Williams Canyon near Manitou, and Boulder (Wheeler); Canyon City (P. J. Schmitt).

Utah: Little Willow Canyon, Salt Lake County (R. V. Chamberlin).

Arizona: Williams, 7000 ft. (Wheeler).

California: Angora Peak, near Lake Tahoe, 8000 ft. (Wheeler).

Ontario: Ottawa (Wheeler).

Quebec: Hull (Wheeler).

Maine: Reed's Island, Penobscot Bay (A. C. Burrill).

Nova Scotia: Digby (J. Russell); Bedford (W. Reiff).

The list of localities shows that this form has a very wide range. It is the most boreal of our forms of *umbratus* and is confined to the Canadian Zone.

86. *Lasius* (*Formicina*) *umbratus* subsp. *mixtus* Nyl. var. *aphidicola* Walsh.

This form, so abundant in many localities east of the Rocky Mts., is very rare further west. During the summers of 1903 and 1906 I found a few colonies near Florissant and Colorado Springs, Colorado. They nest by preference in moderately moist, shady places. This probably accounts for their almost complete absence from the arid portions of the country.

87. *Lasius* (*Formicina*) *umbratus* subsp. *vestitus* Wheeler.

Known only from a female specimen taken by Prof. J. M. Aldrich at Moscow, Idaho.

88. *Lasius* (*Formicina*) *humilis* sp. nov.

Worker. Length 1.5–1.7 mm.

Head as broad as long, a little narrower in front than behind, with broadly and feebly excavated posterior border and feebly and regularly convex sides. Eyes very small, somewhat larger than in the typical *brevicornis*, flat, with only about six ommatidia in their greatest diameter. Antennae slender; scapes extending beyond the posterior

corners of the head, funiculi scarcely enlarged at their tips; joints 2–3 as broad as long, all the other joints distinctly longer than broad, the ninth and tenth being nearly $1\frac{1}{2}$ times as long as broad. Clypeus very bluntly subcarinate. Frontal area large, triangular. Palpi rather long, the six joints of the maxillary pair gradually decreasing in length towards the tip as in other members of the subgenus. Thorax rather short, the pro- and mesonotum together as long as the epinotum; mesonotum as long as broad, the promesonotal suture not deeply impressed; mesoëpinotal constriction short but moderately deep; epinotum in profile with the convex base about $\frac{1}{4}$ as long as the flat, sloping declivity. Petiole narrow and rather high, much compressed anteroposteriorly, with flat anterior and posterior surfaces, straight, nearly subparallel sides and rather sharp, entire and evenly rounded superior border. Gaster broad, flattened dorsoventrally.

Surface shining; mandibles finely striated; remainder of body very finely and superficially shagreened.

Pubescence and hairs pale yellow, the former appressed, abundant and moderately long on the body and appendages, the latter blunt and erect, very sparse on the head, more numerous on the thoracic dorsum and still more abundant on the gaster.

Pale yellow; head and antennae a little darker; mandibles with reddish borders and teeth.

Female. Length 3.5 mm.

Head subrectangular, slightly broader than long, with rather deeply and broadly excised posterior border and straight cheeks. Eyes large, convex, more than half as long as the cheeks. Antennal scapes surpassing the posterior corners of the head by about $\frac{1}{6}$ their length; all the funicular joints distinctly longer than broad. Thorax not broader through the wing-insertions than the head through the eyes, flattened above; mesonotum nearly as long as broad. Petiole with more convex sides and blunter superior border than in the worker, this border feebly emarginate in the middle in some specimens. Wings rather long.

Sculpture and pubescence much as in the worker, erect hairs on the thorax and gaster apparently less numerous and conspicuous.

Color like that of the worker, but the occipital portion of the head, the pro- and mesonotum, scutellum and dorsal surface of the gaster pale brown. Wings grayish, not infuscated at their bases, with pale brown veins and stigma.

Described from nine workers and three females taken by Dr. W. M. Mann at Pyramid Lake, Nevada.

This ant might be regarded as an extreme subspecies of *umbratus*, but the worker and female are decidedly smaller even than the corresponding phases of the eastern subsp. *minutus* Emery, the female, indeed, being smaller than that of any other North American *Lasius*. The different proportions of the funicular joints seem to justify a specific name, as the joints 9 and 10 are very distinctly longer. The eyes of the worker are smaller, the promesonotal suture is much less deeply impressed and the mesonotum much less convex and projecting, the mesoëpinotal impression shallower than in *umbratus* and the petiolar border not so sharp.

89. *Lasius* (*Acanthomyops*) *occidentalis* Wheeler.

Colorado: Colorado Springs and Ute Pass (Wheeler).

New Mexico: Pecos and Trout Spring, Gallinas Canyon (T. D. A. Cockerell); Manzanares (Mary Cooper); Albuquerque (W. H. Long).

This small species is not known to occur east of the Rocky Mts. and appears to have the most limited range of any species of the subgenus.

90. *Lasius* (*Acanthomyops*) *murphyi* Forel.

North Carolina: Morganton, type locality (Forel).

New York: Cold Spring Harbor, L. I. and Bronxville (Wheeler).

Ontario: Toronto.

Colorado: Boulder (P. J. Schmitt and T. D. A. Cockerell).

Montana: Helena (W. M. Mann).

This ant appears to belong to the warmer and dryer portions of the Transition Zone and to be rare in all parts of its range. It forms large colonies under stones in open woods.

91. *Lasius* (*Acanthomyops*) *latipes* Walsh.

California: Mt. Tamalpais (C. G. Hewitt); Mountain View.

Washington: Pullman and Wawawai (W. M. Mann); Almota (A. L. Melander); Rock Lake.

Idaho: Julietta (J. M. Aldrich).

Utah: Salt Lake Co. (R. V. Chamberlin).

Colorado: Manitou and Florissant (Wheeler); Boulder (P. J. Schmitt and T. D. A. Cockerell).

New Mexico: Las Vegas (T. D. A. Cockerell); Albuquerque (W. H. Long).

Illinois: Rockford (Wheeler).

Pennsylvania: Enola.

New Jersey: Weasel Mt. and Lakehurst (Wheeler).

New York: Bronxville and White Plains (Wheeler).

Connecticut: Colebrook (Wheeler).

Massachusetts: Franklin and Boston (Wheeler); Needham (A. P. Morse).

As shown by the list of localities, this species has a very wide range, from Boston to San Francisco. It is rather sporadic and nests under large stones in dry fields and pastures.

92. *Lasius* (*Acanthomyops*) *interjectus* Mayr.

Washington: Pullman (W. M. Mann).

Colorado: Manitou, Cheyenne Canyon and Colorado Springs (Wheeler); Longmont (P. J. Schmitt).

New Mexico: Las Valles (Mary Cooper).

Montana: Flathead Lake (C. C. Adams).

Specimens of all three phases from these localities are indistinguishable from those of the Central and Eastern States where the species is much more common. It nests in rather dry, sunny places. The basal border of the mandibles in the worker and female, is distinctly denticulate, a peculiarity which I have not observed in our other species of the subgenus *Acanthomyops*.

93. *Lasius* (*Acanthomyops*) *interjectus* subsp. *californicus* subsp. nov.

Worker. Length 2.6–3 mm.

Much smaller than the worker of the typical form, which measures 4–5 mm., with the basal border of the mandibles very indistinctly denticulate and the funicular joints of the antennae a little shorter and the scapes much shorter, extending only slightly beyond the posterior corners of the head. The sides of the head are distinctly less convex. The mesoëpinotal constriction is much feebler and the base of the epinotum much less convex, narrower and rounded. Color, sculpture and pilosity much as in the typical form.

Female. Length 7.5 mm.

Somewhat smaller than the typical form and of a different color, the thorax, petiole and gaster being rich reddish castaneous, the head, base of first gastric segment and the appendages red. The infuscation of the bases of the wings is scarcely perceptible. The petiole is much broader and more deeply excised than in the female of the typical *interjectus* and the funicular joints of the antennae are distinctly shorter.

Described from eleven workers taken by myself from a single colony

in Palmer's Canyon, San Gabriel Mts., near Claremont, Cala., at an altitude of about 2000 ft., and a single female from the same mountains (F. Grinnell).

94. *Lasius* (*Acanthomyops*) *interjectus* subsp. *coloradensis* subsp. nov.

Worker. Very similar to the preceding subspecies and of the same size but with distinctly larger eyes and finer and conspicuously more abundant erect hairs on the head, thorax and especially on the gaster. The proportions of the scape and funicular joints and the shape of the thorax and petiole are the same as in *californicus*.

Female. Length 4.5–5 mm.

Decidedly smaller than the female of *californicus*, with the head as well as the thorax deep castaneous. Mandibles, antennae and legs brownish yellow, the femora somewhat infuscated in the middle. Wings grayish hyaline, not darker at the base, the veins and stigma pale. Petiole less deeply emarginate above and much narrower than in *californicus*. Erect hairs on body more abundant.

Male. Length 3 mm.

Much smaller and more pilose than the male of the typical *interjectus*, with uniformly grayish, hyaline wings. The superior petiolar border is noticeably blunter and the funicular joints are distinctly shorter.

Described from a dozen workers and as many females taken by myself at Manitou, Colo. (type locality), Aug. 9, 1903, six workers, seven females and two males taken by Mr. E. Bethel at Denver, a single deälated female taken by Prof. Cockerell at Las Vegas, New Mexico and three workers from Manzanares in the same state (Mary Cooper).

95. *Lasius* (*Acanthomyops*) *interjectus* subsp. *arizonicus* subsp. nov.

Worker. Length 3.5–4.5 mm.

Larger than *californicus* and *coloradensis* but somewhat smaller than the typical *interjectus* and of a slightly paler yellow color. The proportions of the antennal scape and funicular joints and the shape of the thorax are much the same as in *interjectus*, but the petiole is much smaller and narrower. The eyes are considerably larger and more convex. The erect hairs on the head, thorax and gaster are much fewer, there are usually no hairs on the gula, and the pubescence on the body and especially on the gaster is much shorter than in typical *interjectus* so that the surface appears very glabrous and shining.

I took many workers of this species in Miller Canyon, Huachuca Mts., 5000 ft., during November 1910 and received additional material from Mr. Biedermann, who took it in Carr Canyon, and from Dr. W. M. Mann who took it in Ramsay Canyon in the same mountain range. The subspecies is very easily recognized by its larger eyes, peculiar pilosity and very smooth surface.

96. *Lasius* (*Acanthomyops*) *interjectus* subsp. *mexicanus* Wheeler.

I have recently described this subspecies from specimens of all three phases taken by Dr. Mann at Guerrero Mill in the State of Hidalgo, Mexico, at an altitude of 8500–9000 ft.

97. *Lasius* (*Acanthomyops*) *claviger* Roger.

I have seen only a few specimens of this very common eastern species from the west, a worker taken at Old Pecos Pueblo, New Mexico, by Prof. Cockerell and several workers and females taken by Dr. Mann at Helena, Montana. In Massachusetts and Connecticut *claviger* is the most abundant *Acanthomyops*. The small subspecies of *interjectus* described above, show that the species is by no means so distinct from *claviger* as we had supposed. The small form described by Emery from the Eastern States as *claviger* var. *subglaber* should be regarded as a subspecies. I have taken all three phases of it at Rockford, Ill., and on Great Blue Hill, near Boston, Mass., and have seen specimens from the District of Columbia (cotypes from Pergande), Delaware Co., Pa. (Cresson) and Algonquin, Ill. (W. A. Nason). At first sight this form closely resembles *interjectus* subsp. *coloradensis* in size, but the workers and females of this form are much more pilose, the antennal funiculi are distinctly less clavate and the female is much darker.

98. *Formica sanguinea* Latr. subsp. *subnuda* Emery.

British Columbia: Field and Emerald Lake (Wheeler).

Alberta: Lake Louise and Banff (Wheeler).

California: Fallen Leaf Lake and Glen Alpine Springs, near Lake Tahoe (Wheeler); Sugar Pine, Madera County (J. C. Bradley).

Idaho: Troy (W. M. Mann).

Washington: Seattle (Wheeler).

Colorado: San Juan Mts., 12,000 ft., Bullion Peak, Park Co., 13,000 ft., and Gibson's Gulch, Hayden Peak, 10,000 ft. (E. J. Oslar); Tolland (W. W. Robbins).

In my "Revision of the Ants of the Genus Formica" I have cited

this ant from many other localities from British Columbia to Connecticut. It is very widely distributed in the Transition and Canadian Zones. Of the numerous colonies seen in California and British America during the summer of 1915 few contained slaves (*F. fusca*).

99. *Formica sanguinea* subsp. *puberula* Emery.

Arizona: Graham Mts. (E. G. Holt).

Recorded from various localities in South Dakota, Colorado, Utah, Washington, Montana, New Mexico, Texas, Missouri and Illinois.

100. *Formica sanguinea* subsp. *obtusopilosa* Emery.

An imperfectly known subspecies described from a single worker taken in New Mexico.

101. *Formica munda* Wheeler.

Known from several localities in Colorado, New Mexico, South Dakota, Montana and Alberta where it occurs below elevations of 7000 ft.

102. *Formica munda* var. *alticola* var. nov.

Worker. Length 4.5–5 mm.

Differing from the typical *munda* in having the red portions of the body of a much deeper shade, and the petiole and dorsal portion of the head infuscated. The erect hairs on the head and thorax are distinctly more abundant than in *munda.*

Described from seventeen specimens taken by Mr. E. J. Oslar in Jefferson County, Colorado at an altitude of 9500 ft. This is clearly an alpine variety. One of the specimens is a pseudogyne, with very convex pro- and mesonotum and well-developed scutellum and metanotum, but without traces of wings.

103. *Formica emeryi* Wheeler.

Known only from Broadmoor, near Colorado Springs, Colo.

104. *Formica manni* Wheeler.

Idaho: Boise (A. K. Fisher).

Originally described from several localities in Washington and Owen's Lake, California.

105. *Formica perpilosa* Wheeler.

Occurring at rather low elevations in Colorado, New Mexico, Arizona, Western Texas and Northern Mexico.

106. *Formica bradleyi* Wheeler.

Colorado: San Miguel, 12,000 ft. and Bullion Peak, Park Co. 12,000 ft. (E. J. Oslar).

Montana: Missoula.

Previously known only from workers taken at Georgetown, Colo. and Medicine Hat, Alberta. It is evidently an exclusively alpine species. The two specimens from Missoula are females. They measure nearly 7 mm. and are colored like the worker, red throughout, except the posterior borders of the gastric segments which are fuscous. The surface of the body is subopaque. The petiole is cuneate in profile, broad below, with flat anterior and posterior and rather sharp, emarginate superior border. The notch in the middle of the anterior clypeal border is very distinct. The wings are grayish hyaline, with brown stigma and yellowish brown veins.

107. *Formica rufa* L. subsp. *obscuripes* Forel.

British Columbia: Glacier (Wheeler).

Alberta: Banff (Wheeler).

Manitoba: Treesbank (C. G. Hewitt).

Montana: Beaver Creek (S. J. Hunter).

Wyoming: Cheyenne (Fanny T. Hartman): Rock River (S. J. Hunter).

Colorado: Creede, 8844 ft. (S. J. Hunter); Tolland (W. W. Robbins); Jefferson (A. K. Fisher).

California: Tallac, Lake Tahoe (Wheeler).

Washington: The eastern part of the state (W. M. Mann).

The attempts in my "Revision" to dissipate the confusion in regard to our American forms of *rufa*, prove to have been unsuccessful and I must here make another attempt. I believed that I could recognize four forms of this species, the subsp. *obscuripes* Forel, the subsp. *aggerans* (a new name for Emery's *rubiginosa* (*nom. praeocc.*)), the var. *melanotica* Emery and a var. *whymperi* described by Forel as belonging to *obscuripes* but at the time unknown to me. I have since found this variety in British Columbia and am able to state that it does not belong to *rufa* or *obscuripes* but is a distinct species of the *microgyna* group and is very close to the form I described as *F. adamsi* (*vide infra*). The var. *melanotica* is a very definite color variety of *obscuripes* and need not be discussed. Doubt remains then only in regard to the typical *obscuripes* and *aggerans*. Although I studied much material from a number of localities I was unable to distinguish these forms satisfactorily for the reason that both were inadequately

described by Emery and Forel and because the latter published conflicting descriptions of *obscuripes*. His original description (C. R. Soc. Ent. Belg. 1886, p. 2) runs as follows: "Ouvrière. Long. 3.8–8 mm. Très semblable a la *F. rufa i. spec.* d'Europe. Mais elle est plus petite; les grandes ouvrières sont d'un rouge plus clair et presque ou entièrement sans tache sur la tête et le thorax, tandis que les pattes et l'ecaille sont d'un brun noirâtre. Les petites ouvrières sont beaucoup plus foncées et tachées de brun sur la tête et le thorax. L'abdomen est mat, noir, et a une pubescence grise un peu plus forte que chez la *F. rufa i. spec.*, tandis que la pilosité est plutôt un peu plus faible.— Green River, Wyoming (Scudder)." Recurring to this form in connection with his description of *whymperi* (Ann. Soc. Ent. Belg. 48, 1904, p. 152) Forel says: "Emery rattache *l'obscuripes* comme variété a *l'obscuriventris*. Mais *l'obscuriventris* est beaucoup plus poilue et a les tibias garnis de poils dressés, ce qui n'est pas le cas de *l'obscuripes*, dont les tibias n'ont qu' une pubescence adjacente et dont le corps n'a que très peu de poils dressés, beaucoup moins que chez la *pratensis* d'Europe et même que chez la *rufa* typique. Je maintiens donc *l'obscuripes* comme race ou sous-espèce distincte."

Finding that there was considerable variation in the pilosity of my series of *rufa* from different colonies and localities and relying on these descriptions, I naturally referred the more pilose forms to Emery's *rubiginosa* and the less pilose forms to Forel's *obscuripes*. Since the publication of my "Revision" Forel returns to the subject with the following statement (Deutsch. Ent. Zeitschr. 1914, p. 619):

"Ich habe leider bei Gelegenheit der Beschreibung dieser Rasse (*obscuripes*) und bei derjenigen der var. *whymperi* For. die Tatsache übersehen, dass die Originaltypen der *obscuripes*, die ich noch in Anzahl besitze, nicht, wie ich angegeben hatte, ohne abstehende Haare, sondern sehr deutlich, obwohl meistens spärlich abstehend behaart sind. Die Behaarung wechselt, wie Wheeler von *aggerans* angibt, ziemlich stark bei den verschiedenen Individuen und ich hatte bei der Beschreibung ein solches angesehen, wo sie fast oder ganz fehlten, ebenfals ist der Hinterleib matt mit feiner rauher Pubescens, so dass ich mit dem besten Willen keinen Unterschied zwischen *obscuripes* und *aggerans* finden kann und diese beiden Formennamen als synonym betrachten muss; auch die Haare des Hinterleibs sind gleich. Dagegen bleiben die v. *melanotica* Em. und *whymperi* For. (letztere ohne abstehende Haare) bestehen.— Lake Tahoe, Kalifornien."

As I collected many specimens of this ant at Lake Tahoe I am undoubtedly in possession of specimens which Forel now pronounces

to be his *obscuripes*. These also undoubtedly belong to the form I called *aggerans* in my "Revision." They are much more hairy than the European *rufa* and if the Wyoming types of *obscuripes* had been like these it is difficult to see how Forel could have overlooked their striking pilosity and have penned the two descriptions above quoted. Pending a more exhaustive study I am willing, however, to attribute both forms to *obscuripes* and to regard it as a subspecies in which there is considerable variability in pilosity (as in the typical *rufa* of Europe). But as the term *aggerans* was suggested to replace Emery's *rubiginosa* (a preoccupied name), we have still to determine what Emery meant by this form. As he possessed cotypes of *obscuripes* when he wrote the description of *rubiginosa*, the latter was evidently something different. After carefully rereading Emery's description I conclude that he must have had a distinct variety of *obscuriventris* which I believe I am now able to recognize (*vide infra* under the forms of *truncicola*).[3]

108. *Formica rufa* subsp. *obscuripes* var. *melanotica* Emery.
Colorado: Boulder (W. W. Robbins).
Washington: Tacoma (C. C. Adams).
Alberta: Pincher and Lethbridge (C. G. Hewitt).
Manitoba: Treesbank (C. G. Hewitt).

This form, which I have recorded also from Wisconsin, Illinois, South Dakota, Nebraska, Wyoming, Washington and British Columbia, is merely a very dark form of *obscuripes* with only the head red in the largest workers. The true *obscuripes* does not range eastward of the Rocky Mountains.

109. *Formica truncicola* Nyl. subsp. *integroides* Emery.
California: Lake Tahoe (Wheeler).

Recorded previously from several localities both in the Coast Range and in the Sierras of California. The colonies which I saw in large pine logs and stumps near Tallac and Fallen Leaf Lake were very populous like those of the vars. *haemorrhoidalis* and *coloradensis* in the Rocky Mts. The nests were banked with considerable quantities of vegetable detritus.

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[3] Since this paragraph was written I have found two worker cotypes of *F. obscuripes* from Green River, Wyo. in the Pergande Collection (U. S. Nat. Mus.). They have very distinct suberect hairs on the legs, but the pubescence on the gaster seems to be shorter and finer than in workers from Lake Tahoe.

110. *Formica truncicola* subsp. *integroides* var. *tahoënsis* var. nov.

Worker. Length 4–6 mm.

Resembling the subsp. *integroides* but differing in its decidedly smaller average size, in the shape of the head, larger eyes, pilosity and coloration. The head is narrower in front with much less convex, anteriorly converging cheeks and straight posterior border, so that it is distinctly trapezoidal with less rounded posterior corners. Surface of body opaque, mandibles lustrous, frontal area shining. The erect hairs are extremely sparse on the head and thorax, usually restricted to a few scattered hairs on the clypeus and upper surface of the head. Pubescence grayish, abundant, especially on the gaster. Gaster black, with red anal region. In large workers the head, thorax, petiole and appendages are red, with the apical half of the antennal funiculus infuscated, but often even the largest workers have the ocellar triangle, the upper portion of the petiole and a spot on the pro- and mesonotum blackish and the coxae, femora and tibiae dark red or fuscous. The infuscation of the red portions of the body may be even more extensive in small individuals.

Female. Length 8.5–9.5 mm.

Differing from the female *integroides* in lacking erect hairs on the upper surface of the thorax and pedicel, the gula and posterior portions of the head. The head, thorax, petiole and appendages are uniformly red in some specimens, in others the metanotum and posterior portion of the scutellum are black and there may be three elongate black blotches on the mesonotum or only a single anteromedian blotch. Wings grayish hyaline, with their basal halves distinctly infuscated; veins and stigma brown.

Described from numerous workers and four deälated females taken from several colonies near Lake Tahoe, Cala. (Tallac, Glen Alpine Springs, Fallen Leaf Lake, Angora Peak), and a single female taken by Prof. C. F. Baker in Ormsby County, Nevada. In the almost complete absence of erect hairs on the head, thorax and petiole, this variety resembles the var. *haemorrhoidalis*, but the worker averages distinctly smaller, has a differently shaped head and the smaller and even some of the larger workers are more or less spotted with black. It is less hairy than the typical *integroides* and the gaster is darker. Like the other forms of the subspecies it forms large colonies in stumps and logs which it banks with much vegetable detritus.

111. *Formica truncicola* subsp. *integroides* var. *propinqua* var. nov.

Worker. Very similar to the preceding both in size and coloration,

but with more numerous erect hairs on the head, gula, thoracic dorsum and petiolar border than even in the typical *integroides*, and these hairs are coarse and blunt on the thorax. The head is a little less narrowed in front than in the var. *tahoënsis*, the cheeks feebly convex, the eyes of the same size.

Described from numerous specimens taken from several colonies in the same localities as the var. *tahoënsis*. As the differences of pilosity of these two varieties appear to be constant throughout the colonies, it seems necessary to regard them as distinct. It is not improbable that they really belong to different altitudes, *propinqua* preferring the hot moraine region (6000 ft.) between Fallen Leaf Lake and Lake Tahoe and *tahoënsis* the greater elevations (7000–7500 ft.), but as I did not distinguish the two forms in the field, owing to their great similarity in size and color, I am unable to make a positive statement on this matter.

112. *Formica truncicola* subsp. *integroides* var. *coloradensis* Wheeler.

Colorado: Bullion Peak, Park County 12,000 ft., Gibson's Peak, 10,000 ft. and Wilson Peak, 13,000 ft. (E. J. Oslar); Creede 8844 ft. (S. J. Hunter); Tolland (W. W. Robbins).

Known also from other localities in Colorado, from New Mexico and Idaho.

113. *Formica truncicola* subsp. *integroides* var. *haemorrhoidalis* Emery.

Colorado: Creede, 8844 ft. (S. J. Hunter).

This form seems to be more widely distributed than *coloradensis* as it is known to occur in Colorado, South Dakota, Idaho, Nevada and Washington.

114. *Formica truncicola* subsp. *integroides* var. *ravida* Wheeler.

Known only from Elkhorn and Helena, Montana (W. M. Mann).

115. *Formica truncicola* subsp. *integroides* var. *subfasciata* var. nov.

Worker. Length 6–8.5 mm.

Averaging considerably larger and apparently much more feebly polymorphic than the typical *integroides*. Erect hairs on the upper surface of the head, thorax and petiole much less numerous. The red color of the body is paler and clearer and without traces of infuscation even in the smaller workers. Gaster with the base of each of the segments dull red. Tips of antennal funiculi scarcely infuscated. Anus red as in the other forms of the subspecies.

Described from numerous workers taken by Mr. Fordyce Grinnell in Mill Creek Canyon, Wilson Peak, 7500 ft., San Bernardino Mts., Southern California.

116. *Formica truncicola* subsp. *integra* Nyl. var. *subcaviceps* var. nov.

Worker. Length: 6–7.5 mm.

Differing from the typical *integra* in the following characters: Posterior border of head in largest workers more deeply excavated, almost as deeply as in *F. exsectoides* Forel. Whole body and especially the gaster more opaque. Gula and posterior corners of head with numerous, delicate, short, erect hairs. Smallest workers distinctly infuscated, entirely dark brown. Median workers with darker legs and petiolar border.

Male. Length 7 mm.

Differing from the male *integra* in having the petiole more compressed, with sharp, broadly excavated superior border, the head, thorax and petiole covered with abundant, short, delicate, black hairs and in the coloration of the legs and wings. The femora are black, the tibiae and metatarsi yellow, with indications of infuscation in the middle of the fore and middle tibiae. Wings distinctly paler than in the typical *integra*.

Described from a single male and three workers from Medford, Oregon (C. M. Keyes) and two dozen workers taken by Dr. C. G. Hewitt at Dog Lake, Penticton, British Columbia. Six workers taken by Dr. W. M. Mann on San Juan Island, Washington, belong to the same variety but have the upper border of the petiole sharper and more compressed anteroposteriorly.

117. *Formica truncicola* subsp. *mucescens* Wheeler.

Colorado: various localities between 7000 and 8000 ft.

118. *Formica truncicola* subsp. *obscuriventris* Mayr.

Montana: Flathead Lake (C. C. Adams).

Also known from the Eastern and Central States, Ontario, Colorado and British Columbia.

119. *Formica truncicola* subsp. *obscuriventris* var. *aggerans* Wheeler.

British Columbia: Emerald Lake (Wheeler); Carbonate, Columbia R. 2600 ft. (J. C. Bradley).

Utah: Promontory Point (A. Wetmore).

Series of workers from these localities agree perfectly with Emery's

very brief description of the var. *rubiginosa*. The only difference I can detect between this form and the typical *obscuriventris* is the greater infuscation of the thorax and petiole of even the largest workers. Emery records the form from Nebraska, Colorado and Dakota.

120. *Formica foreliana* Wheeler.

Known only from the Huachuca Mts., Arizona, where it was taken by Mr. C. R. Beidermann at altitudes between 4500 and 5600 feet.

121. *Formica ciliata* Mayr.

Colorado: West Cliff, 7864 ft. (T. D. A. Cockerell).

Recorded from various localities in Colorado and Montana.

Several workers taken by Mr. E. J. Oslar in the San Miguel Mts. of Colorado at an elevation of 11,000 ft. seem to belong to this species, but the head is covered with short erect hairs and not naked as in typical ciliata. As there is a possibility that these specimens may represent a new species with aberrant female form like *ciliata, comata, criniventris,* etc., I await further material before introducing another name.

122. *Formica comata* Wheeler.

Known from Colorado and South Dakota.

123. *Formica criniventris* Wheeler.

Recorded from Boulder, Colo. and Helena, Montana.

124. *Formica oreas* Wheeler.

Taken in various localities in Colorado and New Mexico.

125. *Formica oreas* Wheeler var. *comptula* Wheeler.

Known from Pullman, Washington and Elkhorn, Montana.

126. *Formica dakotensis* Emery.

Alberta: Banff (Wheeler).

Colorado: Creede, 8844 ft. (S. J. Hunter).

Previously known from South Dakota, British Columbia and Nova Scotia.

127. *Formica dakotensis* var. *montigena* Wheeler.

Montana: Nigger Hill, Powell Co. (W. M. Mann).

Recorded from Colorado, New Mexico, Montana and Idaho.

128. *Formica dakotensis* var. *saturata* var. nov.

Worker. Length 4.5–5 mm.

Averaging a little smaller than the other forms of the species and of a much deeper color, the head, thorax, petiole and appendages being rich blackish red, nearly as dark as the gaster, the cheeks and anterior portion of the head sometimes a little paler. The pilosity is like that of the typical *dakotensis*, the erect hairs being exceeding scarce on the head and thorax and lacking on the gula.

Described from a dozen workers taken by Dr. W. M. Mann at Helena, Montana.

129. *Formica microgyna* Wheeler.

Known only from Manitou and Florissant, Colo. (7000–8100 ft.).

130. *Formica microgyna* var. *recidiva* Wheeler.

Colorado and New Mexico.

131. *Formica microgyna* subsp. *rasilis* Wheeler.

Colorado: Buena Vista (Wheeler).

Recorded previously from several localities in Colorado, New Mexico, Utah and Washington.

132. *Formica microgyna* subsp. *rasilis* var. *spicata* Wheeler.

Known only from Florissant, Colorado, 8100 ft.

133. *Formica microgyna* subsp. *rasilis* var. *pullula* Wheeler.

Taken at Flathead Lake, Montana, by Prof. C. C. Adams.

134. *Formica microgyna* subsp. *rasilis* var. *nahua* Wheeler.

Taken by Dr. W. M. Mann at Guerrero Mill (9000 ft.) and Velasco in Hidalgo, Mexico.

135. *Formica microgyna* subsp. *rasilis* var. *pinetorum* var. nov.

Worker. Length 3.5–6 mm.

Very similar to the var. *spicata* but differing in the darker, more blackish gaster, its much more abundant, obtuse hairs and the greater tendency to infuscation of the red regions of the body in the large and median workers. In the latter the ocellar region is black and there is a very distinct, elongate triangular black spot on the mesonotum, with dark clouds on the pronotum and occiput. In small workers the infuscation is more extensive on the head and pronotum and the legs and

antennae are darker. The red of the body in larger workers is rather pale and yellowish. The erect hairs are coarse and obtuse and are present on the gula, where none appears in *spicata*.

Described from numerous specimens taken from several colonies on Angora Peak, near Lake Tahoe, California, between 7500 and 8600 ft. These colonies were rather populous and were living under stones and logs banked with vegetable detritus.

136. *Formica microgyna* subsp. *californica* subsp. nov.

Worker. Length 3.5–6.5 mm.

Differing from the other forms of *microgyna* in the sculpture of the integument and in pilosity. The surface of the head, thorax and petiole is so finely and superficially shagreened as to be distinctly shining, and the gaster resembles that of *dakotensis* and *obscuriventris* though more opaque. The pubescence is very short and indistinct and there are no erect hairs on the head, thorax and petiole and only a few on the clypeus. The erect hairs on the gaster are blunt, yellow and sparse. Large workers have the head, thorax, petiole and appendages uniformly red, the gaster black; the median workers have traces of infuscation on the ocellar region, and mesonotum. Small workers have the head and petiole above extensively blackened, the thorax clouded with black even on the sides and the coxae and legs, except the knees and tarsi, fuscous. The petiolar node has a sharp border and in many of the small workers is produced upward as a blunt point in the middle.

Described from numerous workers taken at Glen A'pine Springs, near Lake Tahoe, Cala. (6500 ft.). From one colony of this subspecies on July 26 I took a number of diminutive females resembling those of *microgyna* subsp. *rasilis*, but unfortunately the vial containing them was lost.

137. *Formica microgyna* subsp. *californica* var. *hybrida* var. nov.

Worker. Length 3.5–6.5 mm.

Intermediate between the typical *californica* and the var. *pinetorum*, the color and sculpture being that of the former, the pilosity that of the latter, the pubescence, especially on the gaster, being intermediate.

Numerous workers from several colonies found in the same localities as the var. *pinetorum* on Angora Peak near Lake Tahoe. These may represent a true hybrid form but as I have no proof of their genetic origin, I have preferred to give them a varietal name.

138. *Formica whymperi* Forel.

This form, as above stated, was described by Forel as a mere variety of *F. rufa obscuripes.* During August 1915 I found several colonies of it on the shores of Emerald Lake in British Columbia. It evidently belongs to the *microgyna* group and is specifically the same as my *F. adamsi* described from Isle Royale, Mich. The colonies are rather small and nest under stones and logs which they bank with accumulations of vegetable detritus. The worker of the form which I take to be the same as the type is larger than *adamsi,* measuring 3.5–6 mm. The petiole is blunter and thicker and is produced upward in a blunt point, the hairs on the head and thorax are somewhat less numerous, the dark portion of the gaster is black and not dark brown as in *adamsi* and the black markings of the head and thorax are more pronounced and more sharply outlined in the large workers. *F. adamsi* is, therefore, to be retained as a variety of *whymperi.*

139. *Formica whymperi* var. *alpina* Wheeler.

This variety must also be referred to *whymperi.* I have recorded it from Pikes Peak, 10500–11000 ft., (type locality), Troy, Idaho and Cape Breton Island, but further examination leads me to doubt whether the specimens from the two latter localities really belong to this form. I am not even certain that *whymperi* and *microgyna* are specifically distinct. Both of these forms, with their subspecies and varieties constitute a very difficult complex which can be satisfactorily analyzed only with the aid of more material and with a better knowledge of the males and females than we possess at present.

140. *Formica nevadensis* Wheeler.

Known only from a single female taken in Ormsby County, Nevada by Prof. C. F. Baker. As this county is on the eastern shore of Lake Tahoe we might expect the specimen to be the female of one of the three Californian forms of *microgyna* described above, but this cannot be the case owing to the peculiar abundant pilosity on the body and antennal scapes of the Nevada specimen and the very smooth and shining gaster.

141. *Formica exsectoides* Forel var. *hesperia* Wheeler.

Known only from the vicinity of Colorado Springs.

142. *Formica exsectoides* subsp. *opaciventris* Emery.

Colorado: Creede, 8844 ft. (S. J. Hunter).

Wyoming: Yellowstone National Park (J. C. Bradley).

Montana: Beaver Creek, 6300 ft. (S. J. Hunter).

Previously recorded only from Colorado.

143. *Formica ulkei* Emery.

Manitoba: Treesbank (C. G. Hewitt).

Recorded from South Dakota, Illinois, Nova Scotia and New Brunswick.

144. *Formica fusca* L.

British Columbia: Field and Emerald Lake (Wheeler).

Alberta: McLeod and Jasper (C. G. Hewitt); Lake Louise, Moraine Lake in the Valley of the Ten Peaks, and Banff (Wheeler).

Manitoba: Aweme (N. Criddle).

Washington: Mt. Renier (J. C. Bradley).

California: Kern Lake (J. C. Bradley); Lake Tahoe, 6200–9000 ft. (Wheeler); Camp Curry and Glacier Point, Yosemite, 4000–8000 ft. and Muir Woods, Mt. Tamaplais (Wheeler).

Arizona: San Francisco Mts., 12,000 ft. (W. M. Mann).

Colorado: Creede, 8844 ft. (S. J. Hunter); Chimney Gulch, Golden 14,000 ft.; Bullion Peak, Park County, 14,000 ft.; Clear Creek, Jefferson County, 9500 ft. and Wilson's Peak, 12,000–14,000 ft. (E. J. Oslar).

Montana: Flathead Lake (C. C. Adams); Beaver Creek, 6300 ft. (S. J. Hunter).

Wyoming: Yellowstone National Park (J. C. Bradley).

In my "Revision" I have given a long list of localities of this species, which is the most eurythermal and therefore the most widely distributed of all the species of *Formica* in North America as well as in Eurasia. In the Western States it varies considerably in size and pubescence and in the coloration of the legs and antennae, but I deem it inexpedient to give these varieties names at the present time. Many of them seem to represent transitions between the typical form and the following four varieties:

145. *Formica fusca* var. *subsericea* Say.

I am not sure that this form occurs in the Western States. Specimens referred to this variety on account of their more abundant pubescence are cited from Arizona and Colorado in my "Revision."

146. *Formica fusca* var. *argentea* Wheeler.

Oregon: Ashland (W. Taverner).

California: Angora Peak near Lake Tahoe, 7500–8600 ft. (Wheeler).

Washington: Seattle (Wheeler); Pullman (W. M. Mann); Mt. Renier (J. C. Bradley).

Idaho: Boisé (A. K. Fisher).

Arizona: Graham Mts. (E. G. Holt); San Francisco Mts., (A. K. Fisher).

Colorado: Salida (Wheeler).

Widely distributed through the Transition Zone from the Pacific to the Atlantic Coast.

147. *Formica fusca* var. *marcida* Wheeler.

California: Summit of Angora Peak, near Lake Tahoe, 8650 ft. (Wheeler).

I have recorded this variety from British Columbia, Alberta, Manitoba and Washington. It is a small, depauperate, alpine form. On the bare summit of Angora Peak I found it nesting in little craters in spots from which the snow had recently receded (July 26th). The colonies were small and the ants very active. Prof. Bradley took this variety under very similar conditions at Moraine Lake in the Valley of the Ten Peaks, Alberta. The female measures only 6.5 mm. and has the gaster much more pubescent and much less shining than in the typical *fusca*.

148. *Formica fusca* var. *subaenescens* Emery.

California: Angora Peak, Lake Tahoe, 8600 ft. (Wheeler).

Previously recorded from California, Washington, Idaho, Utah, Colorado, New Mexico, Montana, Alberta, British Columbia and portions of the Middle and Atlantic States.

149. *Formica fusca* var. *gelida* Wheeler.

Recorded from Colorado, New Mexico, Arizona, California, Oregon, Washington, Alaska, British Columbia, Alberta and Saskatchewan.

This is an alpine variety, probably the most stenothermal of all the varieties of *fusca*. In my "Revision" I cited it also from Ontario, Quebec, Labrador, Newfoundland, Nova Scotia, Michigan and New Hampshire, but I have recently shown (Psyche, Dec. 1915, p. 205) that the specimens with this more eastern distribution really constitute a distinct variety, which I have described as var. *algida*.

150. *Formica fusca* var. *neorufibarbis* Emery.

British Columbia: Glacier, Field and Emerald Lake (Wheeler).

Alberta: Lake Louise, Moraine Lake in the Valley of the Ten Peaks (Wheeler); Jasper (C. G. Hewitt).

Washington: Mt. Renier (J. C. Bradley).

California: Lake Tahoe, 6000–7000 ft. and Glacier Point, Yosemite (Wheeler).

Previously cited from various localities in South Dakota, Utah, Montana, Idaho, Oregon, Washington, British Columbia and Alberta.

I found many colonies in the localities above recorded and secured all three phases so that I am able to improve on the description given in my "Revision."

The workers vary greatly in size in each colony, from 3.5–5.5 mm. The largest have the head, including the clypeus, palpi and antennae black, with the scapes, cheeks and mandibles deep red or castaneous, the gaster black and shining, with very short grayish pubescence, the thorax, petiole and legs opaque and immaculate red. The medium-sized workers have a black spot on the pro- and one on the mesonotum; the smallest workers have the whole thorax, petiole and legs dark brown. The petiole is broad, much compressed anteroposteriorly, with broadly rounded, rather sharp border.

The female measures 7–8 mm. and is colored like the worker, except that the sides of the pronotum and the pleurae are clouded with fuscous and the metanotum and posterior border of the scutellum and three large, elongate blotches on the mesonotum are black. The thorax is as shining as the head. The petiole is very broad, very much compressed anteroposteriorly, with flat anterior and posterior surfaces and sharp, broadly rounded superior border. Wings clear grayish hyaline with pale brown veins and dark brown stigma.

The male measures 7–7.5 mm. and is larger than the male of *gelida*. It differs also in having the legs rich yellow, with the base of the femora slightly infuscated and the gaster more shining, with much shorter pubescence and much fewer erect hairs on the head and thorax.

This ant nests by preference in old logs in hot sunny places, but both at Lake Tahoe and in British Columbia I often found it nesting under stones. Several pseudogynes were taken in both localities. They are small (3–4 mm.) and have the dorsal surface of the pro- and mesonotum and the scutellum black.

The specimens cited in my "Revision" as belonging to *gelida* from Blue Lake, Humboldt Co., and Alta Peak, Cala. and from Kassiloff Lake, Kenai Peninsula, Alaska, have the color of the var. *neorufibarbis* but the pubescence of *gelida*. They may be regarded as representing a form intermediate between the two varieties. Owing to its constancy and the pronounced variation in size of the workers of the same colony, *neorufibarbis* should, perhaps, rank as a subspecies.

151. *Formica fusca* var. *neoclara* Emery.

Colorado: Creede, 8844 ft. (S. J. Hunter); Hall's Valley, Park Co., 10,500 ft. and Gibson's Gulch, Hayden Peak, 12,000 ft. (E. J. Oslar).

Recorded only from localities in Colorado. As I have never seen this ant above 7000–8000 ft. the elevations given on Oslar's labels seem excessive. The variety really belongs to higher levels in what Cockerell calls the "sub-alpine zone."

152. *Formica fusca* var. *blanda* Wheeler.

The types of this variety are from Olympia, Washington. Further study shows that the specimens cited in my "Revision" from Seattle, Wash. and Lemon Cove, Tulare Co., Cala. do not belong to it but are pale forms of *cinerea* (*vide infra*). The two workers from the Yosemite are also doubtful as they may be immature specimens of *fusca* var. *marcida*.

153. *Formica fusca* subsp. *pruinosa* subsp. nov.

Worker. Length 3.5–4 mm.

Differing but little in size in the same colony and allied to var. *neoclara*, but with narrower, less flattened gaster. The petiole is similar, with broad, blunt superior border, nearly always distinctly emarginate in the middle. Head scarcely longer than broad, narrowed in front, with straight sides and posterior border. Eyes rather large. Epinotum obtusely angular, with subequal base and declivity.

Surface of body finely shagreened, uniformly shining, except the clypeus and anterior portion of the head, which are coarsely shagreened and opaque.

Whole body uniformly covered with very short, dense, silvery pubescence. Head with only a few pairs of erect hairs on its dorsal surface, thorax and petiole without any; gaster with short, sparse, obtuse hairs.

Gaster dark brown, head black; clypeus and mandibles dark brown, cheeks yellowish brown; thorax, coxae and legs yellowish or reddish brown, the thorax and coxae spotted with dark brown, the spots sometimes fusing so that only the sutures are yellowish or reddish. Petiole often infuscated above. Antennal scapes and base of funiculi red, the tip darker.

Female. Length 6.5–7 mm.

Color, pilosity and sculpture much as in the worker; frontal area yellowish red; pronotum of the same color, with its posterior border and a few spots on the sides fuscous; remainder of thorax fuscous or

blackish, with a few small reddish spots at the anterior end of the mesonotum and on the pleurae. Coxae yellowish red, like the legs. Thorax with erect hairs on the dorsal surface; those on the gaster longer than in the worker and pointed. Petiole broad, much compressed anteroposteriorly, its anterior and posterior surfaces flat, its superior border transverse and emarginate in the middle. Gaster long and narrow, more than twice as long as broad. Wings grayish hyaline, with pale brown veins and dark brown stigma.

Male. Length 7–7.5 mm.

Very similar to the male of the var. *neoclara* but with the coxae and bases of the femora black, the external genitalia more infuscated and the thorax more robust and broader through the mesonotum. Wings like those of the female but with darker veins.

Described from many workers, two males and three females taken from several nests at Emerald Lake, British Columbia, Aug. 12–15 (type locality), a deälated female and several workers from Field, B. C., numerous workers from a single colony which I found at Banff, Alberta and three workers taken at Beaver Creek, Montana (6300 ft.) by Dr. S. J. Hunter.

This form may represent a distinct species, but as the following variety and the var. *blanda* seem to connect it with the var. *neoclara* I have preferred to regard it, at least provisionally, as a subspecies of *fusca.* At Emerald Lake the colonies of *pruinosa* were found only on the open flat delta at the north end of the lake in a rather moist spot traversed by the icy streams from the Emerald Glacier. The nests were peculiar, being small, loose mounds of spruce needles 8 to 12 inches in diameter and of about the same height, built about the trunks of the scattered and stunted bushes. The colonies were very populous. The two seen at Field and Banff were nesting under stones, in the latter locality at the base of Tunnel Mt.

154. *Formica fusca* subsp. *pruinosa* var. *lutescens* var. nov.

Worker. Differing from the typical *pruinosa* in color and in averaging a little smaller. Body and appendages pale brownish yellow, the gaster pale brown, the head behind the frontal area dark brown, the thorax and coxae spotted with pale brown. Antennae scarcely infuscated at the tip. The petiole is narrower and its superior border distinctly blunter than in the typical *pruinosa,* though usually emarginate in the middle. There are no differences in sculpture and pilosity.

Described from numerous workers taken by Dr. W. M. Mann at

Wawawai (type locality), Kiona and Ellensburg, Washington. The specimens from Ellensburg are somewhat darker, with the thorax and petiole uniformly pale brown like the gaster, thus representing a transition to the var. *blanda*.

155. *Formica rufibarbis* Fabr. var. *occidua* Wheeler.

California: Berkeley (Wheeler).

Recorded from many localities in the Coast Range of California and from Wawawai, Washington. As I did not find this ant in the Yosemite or about Lake Tahoe, I infer that it does not occur in the Sierras, at least at elevations above 4000 ft. or east of California.

156. *Formica rufibarbis* var. *gnava* Buckley.

Recorded from various localities in Texas, New Mexico, Arizona, Southern California, Colorado, Utah and Mexico, as far south as the State of Hidalgo. In the northern portion of its range this variety occurs only at low altitudes in warm, shady canyons.

157. *Formica cinerea* Mayr var. *altipetens* Wheeler.

Colorado: Chimney Gulch, Golden, 9500 ft. (E. J. Oslar).

Montana: Beaver Creek, 6300 ft. (S. J. Hunter).

Previously known from Florissant and Cheyenne Mt., Colo., where I found it at elevations between 7000 and 8200 ft., and Pachuca in Hidalgo, Mexico, 9000 ft.

158. *Formica cinerea* var. *neocinerea* Wheeler.

Illinois: Hyde Park, Chicago (Wheeler).

Recorded from Illinois, Indiana, South Dakota, Colorado and California.

159. *Formica cinerea* var. *canadensis* Santschi.

"*Worker.* Length 4.5–6 mm.

Black. Anterior portion of head, antennae, excepting the terminal funicular joints, legs, excepting the coxae and often the middle of the femora, base of the petiole brownish red. Pubescence a little less abundant than in the type. Epinotum a little more angular. Petiole as in the var. *neocinerea* Wheeler, from which it differs, as also from the var. *altipetens* Wheeler, in the entirely black color of the thorax, which makes it resemble *F. fusca* L. var. *subaenescens* Emery.

Female. Length 9–9.5 mm.

The front of the head is nearly black; all the remainder of the body black; antennae and legs as in the worker.

Canada: Saskatchewan (Frey 1909), five workers and six females."

As I have not seen this variety, I quote Santschi's description (Ann. Soc. Ent. Belg. 57, 1913, p. 435). In certain particulars it seems to resemble the form described below as *F. hewitti,* but I cannot suppose that Santschi would have described this form as a variety of *cinerea.*

160. *Formica cinerea* var. *lepida* Wheeler.

Lower California: La Ensenada (F. X. Williams).

California: Lemon Cove, Tulare Co. and Blue Lake, Humboldt Co. (J. C. Bradley).

Washington: Seattle (T. Kincaid and Wheeler).

I found workers of this variety running on the sidewalks in Seattle. Two deälated females taken in the same city by Kincaid measure nearly 9 mm. They are colored like the workers, with the sutures and parapsidal furrows of the thorax blackish.

161. *Formica cinerea* subsp. *pilicornis* Emery.

California: Jacumba (J. C. Bradley).

Recorded only from numerous localities in the Coast Range of California, from San Francisco to San Diego.

162. *Formica sibylla* Wheeler.

California: Yosemite Valley, from Yosemite Village, 4000 ft., to Glacier Point, 8000 ft., and Tallac, Fallen Leaf Lake and the Moraine east of Angora Peak, near Lake Tahoe (Wheeler).

The types of this interesting species were taken by Prof. C. F. Baker in King's Canyon, Ormsby County, Nevada, on the eastern shore of Lake Tahoe. In the Californian localities above cited I saw numerous colonies, each comprising a rather small number of workers and nesting in craters 6 to 8 inches in diameter in sandy soil fully exposed to the sun. The workers, which run very rapidly, were seen outside the nests only during the early morning and late afternoon hours of the hot days of July and August. I failed to secure the hitherto unknown female. In life the worker has a peculiar bronzy appearance owing to the dense and rather long grayish yellow pubescence covering the whole body. It is readily distinguished from the forms of *fusca* by the numerous long, erect hairs on the gula, and from the forms of *cinerea* by the absence of erect hairs on the thorax and petiole, their sparse development on the head and gaster, the less angular epinotum, more slender antennae and less curved scapes.

163. *Formica hewitti* sp. nov.

Worker. Length 5–6 mm.

Resembling a large *F. fusca.* Head a little longer than broad, narrower in front than behind, with straight sides and posterior border. Clypeus sharply carinate, its anterior border produced, rounded, entire. Frontal carinae straight, diverging behind. Antennae as in *F. fusca.* Epinotum in profile with subequal, straight base and declivity, meeting at a pronounced obtuse angle. Petiole convex in front, flat behind, very broad, its superior margin straight and truncated, rather sharp, its sides straight, converging below. Gaster large, elongate.

Head in front and thorax coarsely shagreened. Cheeks with elongate punctures. Mandibles lustrous, densely striate-punctate. Frontal area smooth and shining. Thorax opaque; head somewhat shining, especially behind; gaster more shining, very finely shagreened.

Hairs yellowish, erect, sparse on the upper surface of the head, one or more pairs also on the gula. Upper surface of pro- and mesonotum with numerous short, obtuse hairs. Those on the gaster short, obtuse. Legs naked, except for several erect hairs on the flexor surfaces of the femora. Pubescence grayish, short, uniform over the whole body, conspicuously long, but sparse on the sides of the gula.

Black; thorax dark brown or piceous, mandibles, scapes, three basal joints of funiculus, petiole, coxae and legs deep red.

Female. Length 7 mm.

Very similar to the worker in sculpture, color and pilosity, except that the thorax and petiole are black and the mesonotum and scutellum are shining. The petiole is very broad and compressed antero-posteriorly, its superior border rather sharp, straight and entire. The erect hairs on the mesonotum and scutellum are longer than in the worker and pointed. Wings colorless, with pale yellowish veins and pale brown stigma.

Male. Length 6.5 mm.

Closely resembling the male of the typical *fusca,* but the head, thorax and petiole are much more pilose and with a few erect hairs on the gula, the antennae and mandibles are entirely black, as are also the coxae and basal halves of the femora. The wings are clearer, with paler veins and stigma. The petiole is somewhat broader, with a much more compressed and more deeply emarginate superior border.

This species, dedicated to my friend Dr. C. Gordon Hewitt, is described from numerous workers, three females and a single male which I took from several nests under large stones at Emerald Lake (type locality), at Field, British Columbia, and at Laggan, Alberta. Three workers taken by Prof. C. C. Adams at Flathead Lake, Mon-

tana, and three workers taken by Dr. S. J. Hunter at Beaver Creek, 6300 ft. in the same state also belong to this species, though the thorax in the former is more reddish and the cheeks and clypeus are deep red. Some workers from a single colony at Field seem to represent a hybrid form between *hewitti* and the typical *fusca*. Only an occasional worker in this series has one or two erect hairs on the gula and the color, pubescence and sculpture is more like certain forms of *fusca* that are intermediate between the type and the var. *subsericea*. Like the following species and *F. sibylla, hewitti* is a puzzling form, since, owing to its peculiar pilosity, it cannot be assigned either to *fusca* or to *cinerea*.

164. *Formica subcyanea* Wheeler.

This species is known only from the state of Hidalgo, Mexico, where it was taken in several localities at elevations of about 9000 ft. by Dr. W. M. Mann. The worker and female are readily distinguished by the very opaque, blue-black surface of the body, entirely black legs, antennae and mandibles and the sparse, erect hairs on the gula.

165. *Formica subpolita* Mayr.

California: Mt. Tamalpais (Wheeler).

Oregon: Ashland (W. Taverner).

The typical form of this species is known only from the coast of California, Oregon, Washington and British Columbia. I failed to find it in the Yosemite or about Lake Tahoe though it ascends to an elevation of at least 6400 ft. in the Coast Range in Southern California.

166. *Formica subpolita* var. *camponoticeps* Wheeler.

California: Yosemite Village, 4000 ft. (Wheeler).

This variety has been recorded from several localities in Washington. The Californian specimens agree in all particulars with the types. Each of the numerous colonies which I found nesting under stones on the dry slope of the canyon wall near Yosemite Village contained workers of very different sizes. These colonies were all much less populous than those of the typical *subpolita*, which prefers a moister environment. In several of the nests I took mature larvae of a Coccinellid (*Brachyacantha* sp.) resembling those which occur in the nests of *Acanthomyops*.

167. *Formica subpolita* var. *ficticia* Wheeler.

Montana: Helena and Elkhorn Mts. (W. M. Mann); Flathead Lake (C. C. Adams); Missoula; Gallatin Co., 6500 ft.

Colorado: Boulder and Buena Vista (Wheeler).

The worker of this variety is much less pilose than the typical *subpolita* and the var. *camponoticeps*. In color it is like the latter, with the upper surface of the head darker, but the head of the largest workers is not so large and rectangular and more like that of the typical form of the species.

168. *Formica* (*Proformica*) *neogagates* Emery.

Utah: Promontory Point (A. Wetmore); Salt Lake (T. H. Parks).

The typical form of this species is widely distributed through the Transition Zone from the New England States to Washington and as far north as Quebec, British Columbia and Alberta, but is not known from California.

169. *Formica* (*Proformica*) *neogagates* subsp. *lasioides* Emery.

Recorded from South Dakota, Colorado and Massachusetts.

170. *Formica* (*Proformica*) *neogagates* subsp. *lasioides* var. *vetula* Wheeler.

California: Lake Tahoe, 6000–8000 ft. and Glacier Point, Yosemite, 8000 ft. (Wheeler).

Alberta: Banff (C. G. Hewitt).

Colorado: Chimney Gulch, Golden 9500 ft., and San Juan Mts. 12,000 ft. (E. J. Oslar).

Montana: Beaver Creek, 6300 ft. (S. J. Hunter).

More widely distributed than the typical *neogagates*. All the workers and females from California have the scapes even more distinctly hirsute than many specimens from the Eastern and Central States. This ant is very common at Lake Tahoe and is the summer host of *Xenodusa montana* Casey. I found the larvae of this beetle in the nests both at Tahoe and Glacier Point, but failed to find any pseudogynes in these localities. The winter hosts of the *Xenodusa* are *Camponotus herculeanus* var. *modoc* and *C. laevigatus*.

171. *Formica* (*Proformica*) *neogagates* subsp. *lasioides* var. *limata* Wheeler.

Recorded from Colorado and New Mexico.

172. *Formica* (*Neoformica*) *pallidefulva* Latr. subsp. *schaufussi* Mayr var. *incerta* Emery.

This variety, which is very common throughout the Central and Atlantic States, does not extend westward beyond the Eastern slopes of the Rocky Mts. It has been taken in Colorado and New Mexico.

173. *Formica (Neoformica) pallidefulva* subsp. *nitidiventris* Emery. With the same distribution and western limits as the preceding.

174. *Formica (Neoformica) pallidefulva* subsp. *nitidiventris* var. *fuscata* Emery.

Also known to occur as far west as New Mexico, but more abundant in the Eastern States.

175. *Formica (Neoformica) moki* Wheeler.

Recorded from Arizona and Utah.

176. *Polygerus lucidus* Mayr subsp. *montivagus* Wheeler.

Colorado: Colorado Springs (Wheeler).

The typical *lucidus* is known only from the Eastern and Central States as far west as South Dakota.

177. *Polygerus rufescens* Latr. subsp. *breviceps* Emery.

Colorado; Breckenridge (P. J. Schmitt); Florissant, Ute Pass and Colorado Springs (Wheeler).

New Mexico: Old Pecos Pueblo (T. D. A. Cockerell).

Kansas: Osage City (A. C. Burrill).

Illinois: Algonquin (W. A. Nason); Galesburg (M. Tanquary).

Montana: Elkhorn Mts. (W. M. Mann).

California: Santa Cruz (H. Heath); Kern Lake (J. C. Bradley); Fallen Leaf Lake and Glen Alpine, near Lake Tahoe (Wheeler).

Washington: Pullman (W. M. Mann).

In extending to Illinois this subspecies overlaps the distribution of *lucidus* in the Mississippi Valley. My observations on the slave-raids of *breviceps* at Lake Tahoe are published in the Proc. N. Y. Ent. Soc. 24, 1916, pp. 107–118.

178. *Polyergus rufescens* subsp. *breviceps* var. *montezuma* Wheeler.

Mexico: Pachuca in Hidalgo (W. M. Mann).

179. *Polyergus rufescens* subsp. *breviceps* var. *umbratus* Wheeler.

California: Brookdale (H. Heath).

180. *Polyergus rufescens* subsp. *breviceps* var. *fusciventris* var. nov.

Worker. Length 4 mm.

Differing from the typical *breviceps* in its smaller size, more opaque and more coarsely shagreened surface, in having the petiolar node distinctly shorter and more compressed anteroposteriorly and the

posterior $\frac{2}{5}$ of the first gastric and the whole of the succeeding segments except the anal region, fuscous.

Described from a single worker taken by Prof. T. D. A. Cockerell at the Half Way House on Pike's Peak, Colo. Several workers taken by Dr. C. G. Hewitt at Treesbank, in Southern Manitoba, though slightly larger, also belong to this variety, which is clearly transitional to the subsp. *bicolor* Wasm. The slaves accompanying these specimens belong to the typical *Formica fusca*.

181. *Polyergus rufescens* subsp. *mexicanus* Forel.

This form, described from Mexico, without precise locality, is hardly distinct from the subsp. *breviceps*, to judge from a couple of cotypes received from Prof. Forel.

182. *Polyergus rufescens* subsp. *bicolor* Wasmann.

Wisconsin: Prairie du Chien, type locality (H. Muckermann).

Illinois: Rockford (Wheeler).

Montana: Yellow Bay, Flathead Lake (C. C. Adams).

183. *Polyergus rufescens* subsp. *laeviceps* Wheeler.

California: Mt. Tamalpais, 1000 ft. (Wheeler); Laws (A. Wetmore).

184. *Camponotus laevigatus* F. Smith.

California: Yosemite Village, 4000 ft. and Tallac, Lake Tahoe (Wheeler).

Washington: Seattle (Wheeler).

Montana: Flathead Lake (C. C. Adams).

Colorado: Meeker (W. W. Robbins).

Previously recorded from numerous localities in California, Oregon, Washington, Idaho, Montana, Colorado, Utah, New Mexico, Arizona and Northern Mexico. At Seattle I found its large colonies in huge pine stumps less than 100 feet above sea-level. Further south it is distinctly boreal, rarely, if ever, descending below 4000–5000 ft. and occurring as high as 11,000 ft. on Alta Peak, Cala.

185. *Camponotus herculeanus* L. var. *whymperi* Forel.

Alaska: Seward (F. H. Whitney).

British Columbia: Emerald Lake and Glacier (Wheeler); Arrowhead (C. G. Hewitt).

Alberta: Laggan, Lake Louise and Moraine Lake (Wheeler).

Washington: Mt. Renier (J. C. Bradley).

Colorado: Bullion Peak, Park Co. 12,000 ft.; Chimney Gulch,

Golden, 9500 ft.; San Miguel Mts. 12,000 ft.; Halls Valley, Park Co., 10,500 ft.; Wilson Peak, 13,000 ft. and Bear Creek, Morrison (E. J. Oslar).

Also recorded from many other localities in the Canadian Zone from Alaska and British Columbia to Labrador and Maine.

186. *Camponotus herculeanus* var. *modoc* Wheeler.

California: Nevada Falls, Yosemite (Talcott Williams); Yosemite Village 4000 ft. to Glacier Point 8000 ft. and Lake Tahoe, 6000–9000 ft. (Wheeler).

Washington: Seattle (Wheeler).

Colorado: Creede, 8844 ft. (S. J. Hunter).

British Columbia: Vancouver (Wheeler).

This ant like *C. laevigatus*, descends to sea-level in Washington and western British Columbia, but further south it is subalpine. Huge colonies of it were found at Lake Tahoe nesting in old pine logs and stumps.

187. *Camponotus herculeanus* subsp. *ligniperda* Latr. var. *noveboracensis* Fitch.

British Columbia: Agassiz (C. G. Hewitt).

Common east of the Rocky Mts. It is recorded also from Colorado, Washington, and Oregon.

188. *Camponotus schaefferi* Wheeler.

Known only from the Huachuca Mts., Arizona, where it was taken at altitudes of about 5000 ft. by C. R. Biedermann.

189. *Camponotus texanus* Wheeler.

From low elevations in Central Texas (Travis Co.).

190. *Camponotus sayi* Emery.

Arizona: Graham Mts. (E. G. Holt).

Known also from Phoenix and Prescott in the same state.

191. *Camponotus hyatti* Emery.

California: Palo Alto (W. M. Mann).

Originally taken at San Jacinto, Cala.

192. *Camponotus hyatti* var. *bakeri* Wheeler.

Catalina Island, Cala. (C. F. Baker).

193. *Camponotus fallax* Nyl. var. *nearcticus* Emery.

California: Angora Peak, Lake Tahoe, 7000 ft. (Wheeler).

Recorded also from Washington, Oregon, Idaho, California, and common throughout the Central and Eastern States.

194. *Camponotus fallax* var. *minutus* Emery.

I have referred some specimens from Vancouver to this variety, which, like the preceding is common in the Central and Eastern States.

195. *Camponotus fallax* var. *decipiens* Emery.

Known only from Indiana, Kansas, Colorado and Utah.

196. *Camponotus fallax* subsp. *rasilis* Wheeler.

Ranges through Arizona, Texas and Louisiana to Florida.

197. *Camponotus fallax* subsp. *rasilis* var. *pavidus* Wheeler.

Having much the same distribution as the preceding.

198. *Camponotus fallax* subsp. *subbarbatus* Emery.

According to Emery this form has been taken at Los Angeles, Cala. It is recorded also from Virginia, New Jersey and Illinois.

199. *Camponotus fallax* subsp. *discolor* Buckley.

Very common in Texas and known to extend up the Mississippi Valley to Oklahoma, Missouri and Illinois.

200. *Camponotus fallax* subsp. *discolor* var. *clarithorax* Emery.

This variety was originally described from San Jacinto, and Los Angeles, Cala. I have seen specimens from San Diego, Whittier, Felton, Santa Cruz Mts. and Three Rivers and have taken it in the Santa Inez Mts., near Santa Barbara. It ranges eastward as far as Illinois and Pennsylvania.

201. *Camponotus anthrax* Wheeler.

Known only from the Santa Inez Mts., near Santa Barbara, Cala., where I found it nesting under stones at an altitude of about 1000 ft.

202. *Camponotus* (*Myrmoturba*) *maculatus* Fabr. subsp. *vicinus* Mayr.

Arizona: Grand View, Grand Canyon (Wheeler).

California: Tenaya Canyon, Yosemite, 5000 ft. and Lake Tahoe (Tallac, Glen Alpine Springs and moraine east of Angora Peak),

6000–7000 ft. (Wheeler); Alpine (J. C. Bradley); San Gabriel Mts. near Claremont and Point Loma, near San Diego (Wheeler).

Previously known from several localities in California, Nevada, Oregon, Washington, Idaho, New Mexico and British Columbia.

203. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *plorabilis* Wheeler.

Recorded from California, Nevada and Idaho.

204. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *luteangulus* Wheeler.

British Columbia: Vancouver Island (Pergande Coll.), Dog Lake, Penticton (C. G. Hewitt).

Montana: Flathead Lake (C. C. Adams).

Arizona: Palmer's Canyon, Huachuca Mts. (Wheeler).

This variety is widely distributed as it is known also from other localities in Arizona, from Washington and Idaho. It seems, however, to be rare and sporadic.

205. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *semitestaceus* Emery.

California: San Jacinto Mts. (Fordyce Grinnell); Claremont (Metz); Friant (R. V. Chamberlin); Ramona (J. C. Bradley).

In Emery's "Beiträge," p. 672 this ant was originally described from "Plummer County, Cala., 5000 ft." but no such county exists. Examination of cotypes in the Pergande Collection recently acquired by the National Museum, shows that the specimens came from Plumas County.

206. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *nitidiventris* Emery.

Colorado: Chimney Gulch, Golden and Bear Creek, Morrison (E. J. Oslar); Golden (E. Bethel).

Arizona: Grand Canyon (Wheeler).

Recorded also from many other localities in Colorado, Wyoming, New Mexico and Northern California.

207. *Camponotus* (*Myrmoturba*) *maculatus* subsp. *vicinus* var. *maritimus* Wheeler.

California: Santa Cruz Island (R. V. Chamberlin); Santa Cruz Mts. and Santa Inez Mts. near Santa Barbara (Wheeler).

This form occurs also on Catalina Island and along the coast at Pacific Grove, Cala.

208. *Camponotus (Myrmoturba) maculatus* subsp. *vicinus* var. *infernalis* Wheeler.

California: Tenaya Canyon and Camp Curry, Yosemite 4000–5000 ft. and Lake Tahoe, 6000–7000 ft. (Wheeler); Wilson Peak, San Bernardino Mts., 7500 ft. (Fordyce Grinnell).

Arizona: Williams (Wheeler).

This variety occurs also in New Mexico where I have taken it at Las Vegas. Forel has recently redescribed it (from a single worker minor!) from Lake Tahoe as var. *subrostrata* (Deutsch. Ent. Zeitschr. 1914, p. 620).

209. *Camponotus (Myrmoturba) maculatus* subsp. *dumetorum* Wheeler.

California: Berkeley (Wheeler).

This is a common form in the chaparral of the San Gabriel and Santa Inez Mts. of Southern California up to an altitude of 2000 ft. Forel has recently redescribed it (from a single worker media!) under the name of *C. maculatus maccooki* var. *berkeleyensis* from Berkeley, Cala. (Deutsch. Ent. Zeitschr. 1914, p. 619).

210. *Camponotus (Myrmoturba) maculatus* subsp. *maccooki* Forel.

California: Palo Alto (W. M. Mann); San Ysidro and Carpinteria, near Santa Barbara and Tenaya Canyon, Yosemite 5000 ft. (Wheeler).

Previously recorded from other localities in California, Washington and Oregon. It is confined to the Pacific Coast and western slopes of the Sierra-Cascade Range. I failed to find it about Lake Tahoe.

211. *Camponotus (Myrmoturba) maculatus* subsp. *sansabeanus* Buckley.

Arizona: Miller Canyon, Huachuca Mts.(Wheeler).

Previously recorded from Texas (as far east as Austin), New Mexico, Arizona and Colorado.

212 *Camponotus (Myrmoturba) maculatus* subsp. *sansabeanus* var. *torrefactus* Wheeler.

Originally described from the Grand Canyon, Arizona, 7000 ft. and East Mill Creek, Salt Lake Co., Utah.

213. *Camponotus (Myrmoturba) maculatus* subsp. *bulimosus* Wheeler.

Known only from the canyons of the Huachuca Mts., Ariz. 5000–

6000 ft., where it was repeatedly taken by Dr. W. M. Mann, Mr. C. R. Biedermann and myself.

214. *Camponotus* (*Myrmoturba*) *fumidus* Roger var. *festinatus* Buckley.

Recorded from several localities in Texas, west of Austin and San Antonio, and from Arizona and Mexico as far south as Cuernavaca.

215. *Camponotus* (*Myrmoturba*) *fumidus* var. *fragilis* Pergande.

Taken by Dr. G. Eisen at San Jose del Cabo and San Fernando, Lower California.

216. *Camponotus* (*Myrmoturba*) *fumidus* var. *spurcus* Wheeler.

Described from Western Texas and the Huachuca Mts. Ariz.

217. *Camponotus* (*Myrmoturba*) *vafer* Wheeler.

Known only from the Huachuca Mts., Ariz.

218. *Camponotus* (*Myrmoturba*) *acutirostris* Wheeler.

Originally described from Alamogordo in the foot-hills of the Sacramento Mts., New Mexico (G. v. Krockow) and Box Canyon in the same region (A. G. Ruthven).

219. *Camponotus* (*Myrmoturba*) *acutirostris* var. *clarigaster* Wheeler.

Known only from the Grand Canyon, Ariz., 3000 ft.

220. *Camponotus* (*Myrmoturba*) *ocreatus* Emery.

Emery described this ant as a subspecies of *maculatus* from the Panamint Mts., Cala. Not having seen worker specimens I long suspected that it might prove to be identical with my *acutirostris* from Arizona. Recently I found a fine series of cotypes of *ocreatus* in the Pergande Collection (U. S. Nat. Mus.) and these show that the form is not only distinct from the typical *acutirostris* but that it is an independent species. The worker major of *ocreatus* has a much broader head, the clypeus is broader than long and its median lobe, though somewhat acute, is much shorter, less projecting and less angular than in *acutirostris*. The frontal carinae of the latter are much more lyriform and the color is different. In *ocreatus* the whole head, including the mandibles, clypeus, scapes and first funicular joint, is black, as are also the tibiae, the tips of the femora and the dorsal surface of the pronotum and anterior portion of the mesonotum. The cheeks lack erect hairs and foveolae. My subsp. *primipilaris*, however, evidently

belongs to *ocreatus* and not to *acutirostris*. It is larger than the typical *ocreatus*, has much the same coloring of the legs and thorax and a similar clypeus, but the gaster is darker, the mandibles and clypeus are largely red and only the base of the first funicular joint is black. The Pergande Collection also contains specimens of the typical *ocreatus* labeled "St. Francis Mts., Mexico."

221. *Camponotus* (*Myrmoturba*) *ocreatus* subsp. *primipilaris* Wheeler.

Known only from Nogales and the Huachuca Mts. of Arizona, 5000–6000 ft. It has been repeatedly taken in the latter locality by Dr. W. M. Mann, Mr. C. R. Biedermann and myself.

222. *Camponotus* (*Myrmamblys*) *bruesi* Wheeler.

From Fort Davis, Texas, Chihuahua and Guadalajara, Mexico.

223. *Camponotus* (*Myrmobrachys*) *mina* Forel.

Known only from Cape St. Lucas at the tip of Lower California.

224. *Camponotus* (*Myrmobrachys*) *mina* subsp. *zuni* Wheeler.

Taken at Tucson, Arizona.

225. *Camponotus* (*Colobopsis*) *ulcerosus* Wheeler.

Known only from the canyons of the Huachuca Mts., Arizona, (5500–6000 ft.).

226. *Camponotus* (*Colobopsis*) *yogi* Wheeler.

Taken by Mr. Percy Leonard on Point Loma, near San Diego, California, nesting in twigs of manzanita.

227. *Camponotus* (*Colobopsis*) *abditus* For. var. *etiolatus* Wheeler.

Known from various localities in Western and Central Texas where it nests in pecan twigs and live oak galls.

228. *Camponotus* (*Colobopsis*) *pylartes* Wheeler.

Texas and Louisiana, nesting in twigs.

229. *Camponotus* (*Colobopsis*) *pylartes* var. *hunteri* Wheeler.

A pretty color variety of the preceding taken at Victoria, Texas, in twigs of pecan trees. This and the preceding form belong more properly to the Louisianian fauna.

Bibliography.

Adams, C. C.

1902. Postglacial Origin and Migration of the Life of the North-eastern United States. Journ. Geogr. 1, 1902, pp. 203–310, 352–357.

——— **1902a.** Southeastern United States as a center of Geographical Distribution of Flora and Fauna. Biol. Bull. 3, 1902, pp. 115–131.

——— **1905.** The Postglacial Dispersal of the North American Biota. Biol. Bull. 9, 1905, pp. 53–71, 1 fig.

Allen, J. A.

1878. The Geographical Distribution of the Mammalia, Considered in Relation to the Principal Ontological Regions of the Earth, and the Laws that Govern the Distribution of American Life. Bull. U. S. Geol. Surv. No. 2, vol. 4, 1878, pp. 313–377.

——— **1891.** The Geographical Distribution of North American Mammals. Bull. Amer. Mus. Nat. Hist. 4, 1891, pp. 199–243, 4 maps.

——— **1893.** The Geographical Origin and Distribution of North American Birds Considered in Relation to the Faunal Areas of North America. The Auk, 10, 1893, pp. 97–150.

Bailey, V.

1905. Biological Survey of Texas. North American Fauna No. 25, U. S. Dept. Agric. Biol. Surv. 1905, 222 pp., 24 figs., 16 maps.

——— **1913.** Life Zones and Crop Zones of New Mexico. North American Fauna No. 35, U. S. Dept. Agric. Bur. Biol. Survey, 1913, 100 pp., 16 pls., 6 text figs.

Brauer, A.

1887. Die arktische Subregion. Ein Beitrag zur geographischen Verbreitung der Thiere. Zool. Jahrb. Abth. f. Syst. 3, 1887, pp. 189–308.

Cary, M.

1911. A Biological Survey of Colorado. North Amer. Fauna No. 33, U. S. Dept. Agric. Bur. Biol. Surv. 1911, 256 pp., 39 figs., 1 map.

Clark, A. H.

1915. The Present Distribution of the Onychophora, a Group of Terrestrial Invertebrates. Smithson. Misc. Coll. 65, No. 1, 1915, pp. 1–25.

Cockerell, T. D. A.

1893. The Entomology of the Mid-Alpine Zone of Custer County, Colorado, Trans. Amer. Ent. Soc. 20, 1893, pp. 305–370.

Emery, Carlo.

1891. Le Formiche dell' Ambra Siciliana nel Museo Mineralogico dell' università di Bologna. Mem. R. Accad. Sc. Ist. Bologna 5, 1891, pp. 141–165, 3 pls.

———

1894–95. Beiträge zur Kenntniss der nordamerikanischen Ameisen-fauna. Zool. Jahrb. Abth. f. Syst. 7, 1893, pp. 633–682, 1 pl.; 8, 1894, pp. 257–360, 1 pl.

Forel, A.

1874. Les Fourmis de la Suisse. Nouv. Mém. Soc. Helv. Sc. Nat., Zürich, 26, 447 pp., 2 pls., 1874.

Girard, M.

1868. Note sur l'Entomologie de l'Amerique du Nord, considerée spécialement au point de vue des espèces indentiques et analogues a celles d'Europe. Ann. Soc. Ent. France (4) 8, 1868, pp. 287–296.

Grote, A. R.

1875. The Effect of the Glacial Epoch upon the Distribution of Insects in North America. Ann. Mag. Nat. Hist. (4) 16, 1875, pp. 440–442.

Haacke, W.

1887. Der Nordpol als Schöpfungszentrum der Landfauna. Biol. Centralbl. 6, 1887, pp. 363–370.

Hamilton, John.

1894. Catalogue of the Coleoptera Common to North America,

Northern Asia and Europe (2nd ed.) Trans. Amer. Ent. Soc. 21, 1894, 345–416.

Handlirsch, A.

1908. Die fossilen Insekten und die Phylogenie der Rezenten Formen. Wien, 2 vols. 1908.

——— **1909.** Ueber Relikte. Verhandl. K. K. zool. bot. Ges. Wien. 1909, pp. 183–207.

——— **1913.** Beiträge zur exakten Biologie. Sitzb. K. K. Akad. Wiss. Wien. math. nat. wiss. Kl. 122, 1913, pp. 212–361, 1 diagr., 5 maps.

——— **1913a.** Ueber einige Beziehungen zwischen Palaeontologie, Geographischer Verbreitung und Phylogenie der Insekten. Trans. 2nd Internat. Congr. Ent. (1912) 1913, pp. 248–270, 3 pls.

Heer, O.

1848. Ueber die vorweltlichen Käfer von Oeningen, die Florfliegen, fossile Ameisen. Mitth. Naturf. Ges. Zürich 1, 1848.

——— **1849.** Die Insektenfauna der Tertiärgebilde von Oeningen und von Radoboj in Croatien. Neue Deutschr. Allgem. Schweiz. Ges. Naturw. 11, 1849, pp. 1–264, 17 pls.

Horvath, G.

1908 Les Relations entre les Faunes Hémiptérologiques de l'Europe et de l'Amérique du Nord. Ann. Hist. Nat. Mus. Nat. Hungarici 6, 1908, pp. 1–14.

Huber, P.

1810. Recherches sur les moeurs des Fourmis Indigènes. Paris et Genève, 1810.

von Ihering, H.

1891. On the Ancient Relations between New Zealand and South America. Trans N. Z. Inst. 24, pp. 431–445.

——— **1907.** Archhelenis und Archinotis. Leipzig, 1907.

——— **1908.** Die Entstehungsgeschichte der Fauna der Neotropischen Region. Verh. K. K. zool. bot. Ges. 1908, pp. 282–302.

von Ihering, H.

1911. Die Unwandlungen des amerikanischen Kontinentes während der Tertiärzeit. Neu. Jahrb. f. Mineral., Geol. u. Paläont. Beilage Bd. 32, 1911, pp. 134–176, 1 pl.

Kolbe, H. J.

1913. Die Differenzierung der zoogeographischen Elemente der Kontinente. Trans. 2[nd] Internat. Congr. Ent. (1912) 2, 1913, pp. 433–476.

Le Conte, J. L.

1878. The Coleoptera of the Alpine Regions of the Rocky Mountains. Bull. U. S. Geolog. Sur., 4, 1878, pp. 447–480.

Linder, C.

1908. Observations sur les Fourmilières Boussoles. Bull. Soc. Vaud. Sc. Nat. (5) 44, 1908, pp. 303–310, 5 figs.

Lutz, F. E.

1916. The Geographic Distribution of Bombidae (Hymenoptera) with Notes on Certain Species of Boreal America. Bull. Amer. Mus. Nat. Hist. 35, 1916, pp. 501–521, 2 figs.

———

1916a. Faunal Dispersal. Amer. Natur. 50, 1916, pp. 37—384.

Matthew, W. D.

1906. Hypothetical Outlines of the Continents in Tertiary Times. Bull. Amer. Mus. Nat. Hist. 22, 1906, pp. 353–383, 7 maps.

———

1915. Climate and Evolution. Ann. N. Y. Acad. Sc. 24, 1915, pp. 171–318, 33 figs.

Mayr, G.

1867. Vorläufige Studien uber die Radoboj-Formiciden. Jahrb. K. K. geol. Reichsanst. 17, 1867, pp. 47–62, 1 pl.

———

1868. Die Ameisen des baltischen Bernsteins, Beiträge z. Naturk. Preussens herausgeg. v. d. physik-ökon. Ges. Königsberg 1, 1868, 102 pp., 4 pls.

Merriam, C. H.

1890. Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado, Arizona, North American Fauna, No. 3, U. S. Dept. Agric. Div. Ornith. and Mam. 1890, 136 pp., 13 pls., 5 maps 2 text figs.

Merriam, G. H.

1892. The Geological Distribution of Life in North America. Proc. Biol. Soc. Wash. 7, 1892, pp. 1–64.

——— **1898.** Life Zones and Crop Zones of the United States. Bull. No. 10, U. S. Dept. Agric., Div. Biol. Survey, 1898, 73 pp., 1 pl.

——— **1899.** Results of a Biological Survey of Mt. Shasta, California. North Amer. Fauna No. 16. U. S. Dept. Agric., Div. Biol. Survey, 1899, 179 pp., 46 figs.

Moschler, H. B.

1884. Die Nordamerika und Europa gemeinsam angehörigen Lepidopteren. Verh. K. K. zool. bot. Ges. Wien. 1884, pp. 273–320.

Osborn, H. F.

1910. The Age of Mammals in Europe, Asia and North America. New York, The Macmillan Company, 1910.

Osten-Sacken, C. R.

1877. Western Diptera: Descriptions of Genera and Species of Diptera from the Region West of the Mississippi and Especially from California. Bull. U. S. Geol. and Geogr. Surv. 3, 1877, pp. 189–354.

Pfeffer, G.

1891. Versuch über die erdgeschichtliche Entwickelung der jetzigen Verbreitungsverhältnisse unserer Tierwelt. Hamburg, L. Friederichsen & Co., 1891, 62 pp.

Sanderson, E. D.

1908. The Influence of Minimum Temperatures in Limiting the Northern Distribution of Insects. Journ. Econ. Ent. 1, 1908, pp. 245–262, 7 maps.

Scharff, R. F.

1907. European Animals: Their Geological History and Geographical Distribution. New York, E. P. Dutton & Co., 1907.

1912. Distribution and Origin of Life in America. New York, The Macmillan Company, 1912.

Schwarz, E. A.

1890. On the Coleoptera Common to North America and Other Countries. Proc. Ent. Soc. Wash. 1, 1890, pp. 182–195.

Scribner, G. H.

1882. Where did Life Begin? A brief Inquiry as to the Probable Place of Beginning and the Natural Courses of Migration therefrom of the Fauna and Flora of the Earth. New York, Chas. Scribner's Sons. First ed. 1882, 2nd ed. 1903.

Scudder, L. H.

1894. The Effect of Glaciation and of the Glacial Period on the Present Fauna of North America. Amer. Journ. Sci. 48, 1894, pp. 179–187.

Shelford, V. E.

1914. The Significance of Evaporation in Animal Geography. Ann. Assoc. Amer. Geogr. 3, 1914, pp. 29–42.

Wasmann, E.

1907. Ameisennester " Boussole du Montagnard." Naturwiss. Wochenschr. N. F. 6, 1907, pp. 391, 392, fig.

Webster, F. M.

1901. The Trend of Insect Diffusion in North America. 32 Ann. Rep. Ent. Soc. Ontario, 1901, pp. 63–67, 3 maps.

Wheeler, W. M.

1905. Ants from the Summit of Mount Washington. Psyche, Dec. 1905, pp. 111–114.

———

1905a. The North American Ants of the Genus Liometopum. Bull. Amer. Mus. Nat. Hist. 21, 1905, pp. 321–333, 3 figs.

———

1910. Ants, Their Structure, Development and Behavior. New York, The Columbia University Press, 1910.

———

1910a. The North American Forms of Camponotus fallax Nylander. Journ. N. Y. Ent. Soc. 18, 1910, pp. 216–232.

———

1910b. The North American Ants of the Genus Camponotus Mayr. Ann. N. Y. Acad. Sc. 20, 1910, pp. 294–354.

———

1913. A Revision of the Ants of the Genus Formica (Linné) Mayr. Bull. Mus. Comp. Zoöl. 53, 1913, pp. 379–565, 10 maps.

———

1914. The Ants of the Baltic Amber. Schrift. physik.-ökon. Ges. Königsberg 55, 1914, pp. 1–142, 66 figs.

Wieland, G. R.

1903. Polar Climate in Time the Major Factor in the Evolution of Plants and Animals. Amer. Journ. Sci. 76, 1903, pp. 401–403.

Wilser, L.

1909. Der Nordische Schöpfungsherd. Zeitsch. f. d. Ausbau d. Entwicklungslehre 3, 1909, pp. 121–138.

Zschokke, F.

1907. Die Postglaziale Einwanderung der Tierwelt. Verhand. Schweiz. naturf. Ges. 1, 1907, pp. 136–150.

———

1908. Die Beziehungen der mitteleuropäischen Tierwelt zur Eiszeit. Verhandl. Deutsch Zool. Ges. 1908, pp. 21–77, 2 pls.